

ANNUAL REPORT Ontario Water Resources Commission 1960

K. Symons

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A. Symons -

*This is the revised report but
still contains errors.*

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ANNUAL REPORT
Ontario Water Resources Commission
1966




ONTARIO WATER RESOURCES COMMISSION
OFFICE OF THE CHAIRMAN

March 31st, 1967.

To the Honourable J. R. Simonett,
Minister of Energy and Resources Management.

Sir,-- I have the honour to present for your
approval the Eleventh Annual Report of the
Ontario Water Resources Commission, made in
conformity with and under provisions of The
Ontario Water Resources Commission Act.

Respectfully submitted,


Chairman.



ONTARIO WATER RESOURCES COMMISSION
OFFICE OF THE GENERAL MANAGER

March 31st, 1967.

Dr. James A. Vance,
Chairman,
Ontario Water Resources Commission,
801 Bay Street,
Toronto 5, Ontario.

Dear Sir:

It is with pleasure that I present to
you and the other members of the Ontario Water
Resources Commission the Eleventh Annual Report
of the Commission.

Yours sincerely,


General Manager.

Ontario Water Resources Commission



Dr. J. A. Vance *Chairman*
J. H. H. Root *Vice Chairman*

Commissioners

H. Brown, W. D. Conklin, Q.C.,
L. E. Venchiarutti, D. A. Moodie

D. S. Caverly *General Manager*
W. S. MacDonnell *Commission Secretary*

STAFF ORGANIZATION AS OF DECEMBER 31, 1966:

GENERAL MANAGER **D. S. CAVERLY**
ASSISTANT GENERAL MANAGERS **L. E. OWERS, K. H. SHARPE, F. A. VOEGE, A. K. WATT**
COMMISSION SECRETARY **W. S. MACDONNELL**
ASSISTANT TO THE GENERAL MANAGER **L. M. TOBIAS**

ADMINISTRATIVE BRANCHES

INFORMATION: INFORMATION OFFICER **J. C. SCOTT**
LEGAL: SENIOR SOLICITOR **H. LANDIS**
PERSONNEL: PERSONNEL DIRECTOR **A. R. W. UREN**
SYSTEMS AND E. D. P.: S. AND P. OFFICER **E. V. SANDERS**
SUPPLY: PROCUREMENT OFFICER **A. NORTH**

DIVISION OF CONSTRUCTION

A. W. Shattuck Director **J. C. F. Macdonald** Assistant Director

DIVISION OF FINANCE

D. A. Joynt Comptroller and Director **E. F. Heath** Assistant Comptroller

DIVISION OF INDUSTRIAL WASTES

D. P. Caplice Director **H. A. Clarke** Assistant Director

DIVISION OF LABORATORIES

J. H. Neil Director

DIVISION OF PLANT OPERATIONS

B. C. Palmer Director **C. W. Perry** Assistant Director

DIVISION OF PROJECT DEVELOPMENT

P. G. Cockburn Director

DIVISION RESEARCH

A. J. Harris Director

DIVISION OF SANITARY ENGINEERING

J. R. Barr Director **G. R. Trewin** Assistant Director

DIVISION OF WATER RESOURCES

K. E. Symons Director **D. N. Jeffs** Assistant Director

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Introduction

Interest among municipalities in the provision of water supply and sewage treatment facilities on the basis of provincial financing accounted for a major portion of the Commission's expanded program in 1966. By the end of December the Commission had entered into negotiations with some 97 municipalities, with projects actually being developed in 84 of these. Altogether, 109 provincial projects are in various stages of development. The first of these, the Lake Huron Water Supply System – a pipeline project which will bring water from Lake Huron to the City of London and to participating municipalities along the pipeline route – is now nearing completion.

Other highlights of the year's activities included the Commission's industrial waste pollution control program, the Northern Water Resources Survey and the Great Lakes Water Quality Surveys.

With respect to the first of these, substantial progress was made during the year towards the achievement of industrial waste control objectives. This includes not only major industries but secondary industries such as the cheese and milk, the slaughterhouses and meat processing, and the food processing industries. The Commission is also working in close co-operation with representatives of the mining industry to ensure that waste control measures are undertaken at all new mining sites and that existing disposal procedures at established mining areas are kept under close scrutiny.

Work continued during the year on the Northern Water Resources Survey initiated in 1965 to determine the water resources contained in those basins drained by the five main

rivers flowing into Hudson Bay and James Bay. During 1966 a study of the Attawapiskat River basin was done under contract with a firm of consulting engineers. The latter's work included a study of the stream characteristics, correlation of precipitation, streamflow and evapotranspiration, and an investigation of other features of the area.

With three vessels being employed in its Great Lakes Water Quality Surveys, the Commission is moving forward on this important program to determine the extent of pollution in these waters and to recommend remedial measures for pollution abatement. This work is being carried out as part of a co-ordinated program with the International Joint Commission and agencies of the Federal Government and of the United States. Special facilities for sample analysis were operated at the Commission's Toronto laboratory as well as at an additional laboratory set up for this purpose in the City of London.

Other developments of note during the year were the adoption of amendments to the Plumbing Regulation, the drawing up of a Regulation governing the discharge of wastes from pleasure-craft and the approval of important amendments to the OWRC Act.

As the Province continues to develop, it is imperative that long-range planning be undertaken with respect to future water supply and sewage treatment needs. For this reason the Commission is proceeding with the development of regional studies. A number of these studies are being carried out in various parts of the Province at the present time.

Details of the Commission's overall program during 1966 follow.

Information Branch

JOHN C. SCOTT *Information Officer*

Keeping Ontario informed concerning the Commission, its objectives and its programs through as many media as possible, was once again the prime function of the Information Branch.

The usual programs, involving news releases, exhibits, advertising and distribution of informative and educational publications and posters, continued at an increased rate with a new approach being made through an outdoor billboard poster campaign in certain resort areas during part of the summer.

The impact of an overall OWRC "Clean Water" campaign was increased by use of the billboard poster design – a small fish making a plea to "Keep Our Lakes and Rivers Clean" – on smaller, colourful, eleven-by-fourteen-inch cardboard posters, waterproofed for outdoor use, and on small, attractive 1967 desk calendars.

All Commission display advertising was handled by the Information Branch as were tender-call advertisements in connection with the construction of OWRC water supply and pollution control projects.

In certain instances, the issuing of news releases was combined with the efforts of the Branch's photographic section in the production of pictorial features which were well received by the media involved. An example was the production of four special releases dealing with the work of three OWRC vessels engaged in survey work on the Great Lakes. These were well supported with pictures. Some motion picture footage was made in this connection and used by a Canadian Broadcasting Corporation outlet as part of a water pollution television program. The Great Lakes program also was brought to public attention through use of special thirty-by-forty-inch posters in libraries and post offices in areas visited by the vessels.

Other articles about OWRC activities, which proved popular with various media, and each of which had pictorial support, concerned the testing of DDT substitutes, a description of the OWRC chemical application program, and the installation of the Lake Huron Water Supply System intake crib.

Including the above features, 135 items were carried as news releases in Information Services mailings. They concerned steps taken by industry to curb industrial pollution, the adoption of a regulation governing sewage storage and disposal aboard pleasure craft, research projects including a study which indicated that sewage lagoons control viruses, official OWRC statements, construction contract awards, various Commission water-supply and water-pollution control projects, and other OWRC activities.

In addition to this more or less routine service, requests for special material from publications, such as trade journals and newspapers and from radio and TV stations were promptly met. Speech material was provided on numerous occasions.

An important part of the Branch's program continued to be in the exhibits field with two major exhibits as well as several smaller ones. An all-new travelling exhibit was designed by staff for such shows as the Canadian National Sportsmen's Show in Toronto, the Canadian Lakehead Exhibition at Fort William, the Belleville Industrial Exhibition, the Aylmer and East Elgin Agricultural Fair, the London Western Fair, the Lindsay Central Exhibition, the Central Ontario Exhibition at Kitchener, Simcoe's Norfolk County Fair, the International Plowing Match at Seaforth and Toronto's Royal Agricultural Winter Fair.

The main OWRC exhibit, at Toronto's Canadian National Exhibition, was partially redesigned. Other exhibits were arranged for the Canadian Chemical Producers Conference in Toronto, the Leamington Fair, and a United Nations food fair in Toronto's Yorkdale Plaza. The Branch assisted the Division of Water Resources with displays at the Canadian Water Well Contractors' Association at London, and the Tobacco Growers Equipment and Supply Trade Fair at Aylmer.

Exhibit pieces were put out on loan, on occasion, to associations and schools.

There were a few special ceremonies for which the Information Branch made arrangements during the year. Among them were the official opening of the Town of Southampton's OWRC-built water supply system, and a special press inspection of the Commission's Great Lakes Survey laboratory at London.

Production and distribution of literature was a most important and active part of the Information Branch work. Two major items in 1966 were the OWRC booklet, which tells the story of the Commission, and the "Story of Water" – the most popular publication produced by the Branch. The OWRC booklet was revised and up-dated while the "Story of Water", also up-dated, acquired a new and improved cover design. Another popular item, the Hydrologic Cycle, was revised and produced in pamphlet form.

Teachers' or educational kits, introduced in 1965 and containing most items in the OWRC list of publications, again proved to be a popular and important item in the Branch information-educational program. More than 7,000 kits were distributed in special envelopes, while a complementary item, the water resources classroom poster – also produced for the first time in 1965 – continued to be in demand. More than 2,000 of these posters were distributed in 1966.

Close to 15,000 copies of the "Story of Water" were distributed in kits – individually, by mail and at the various exhibitions and fairs.

One new publication, "A Visit to a Water Pollution Control Plant", was produced during the year. A companion piece, "A Visit to a Water Purification Plant" was reaching the layout stage as the year ended.

There was a marked increase during the year in requests by mail and by telephone for the Commission's publications, most of the requests coming from students and teachers. This is an indication of the increasing interest in the subject of water resources, the related fields of water supply and pollution control,

and the work of the OWRC. It was apparent that the study of water resources was being included in the curricula of classes in many schools. There was great interest at the university level also.

The photographic section of the Information Branch spent an active year and recorded, pictorially, practically all phases of Commission activity. It filled requests from various publishers for all types of pictures related to water resources and the work of the Commission.

In addition, work continued on the filming and putting together of a motion picture of the construction of the Lake Huron Water Supply System. This film was scheduled to be available not long after the opening of the System, possibly late in 1967. A record of construction progress also was recorded by still cameras.

Aerial photographic assignments were carried out and a photographic record was compiled of the work of the OWRC's Great Lakes' vessels.

Legal Branch

H. LANDIS *Senior Solicitor*

During the year the legal office provided a general advisory service to the Commission and to its personnel, supervised legal actions conducted on behalf of the Commission and prepared agreements and other legal documents.

There were important amendments to THE OWRC ACT in 1966. These had reference to:

- regulations requiring sanitary facilities on boats.
- acquisition of land analogous to easements for sewage or water works without the necessity of it being appurtenant to other land of the Commission or the municipality.
- reducing the period within which an *ex parte* injunction, obtained for the purpose of preventing pollution, can be granted to the Commission.

- interference with a public or private interest in water by reason of the leaking or flowing of water from a well or excavation in the ground.
- establishment of a sewage works or extension of sewage works by one municipality in another.
- prepayments by municipalities to reduce the cost of projects, municipal water works rates to pay annual project charges, the annual interest charges for projects.
- establishing public water and sewage service areas, where the Commission is empowered to impose terms and conditions, with respect to water or sewage service.
- the licensing of persons operating equipment for the boring or drilling of wells.
- municipal by-laws respecting plumbing.
- plumbing regulations.

Personnel Branch

A. R. W. UREN *Director*

Activities in the Personnel Branch accelerated during the year 1966. Although the Commission salary appropriation and authorized complement were known at a relatively early date, the full implication of new or expanded programs was not realized until January on the eve of the professional recruitment programs.

Initial planning commenced three months earlier for the recruitment of engineers, scientists, technologists and technicians. In recent years this has become a seasonal activity. For the first time it was extended beyond the Province.

The recruitment program derived the fullest co-operation from supervisors of the line organization who participated in forming recruiting teams.

During the period from January 1 to March 31, twenty Canadian universities were visited. Despite a late start, approximately

170 candidates from graduating classes applied for interviews. Of this group, 56 were selected for offers of employment. The program resulted in the appointment of 19 graduates to OWRC staff. This represented approximately 66 per cent of the objective.

In addition to engineers, graduating technology students were interviewed for technical positions. A total of 27 applicants were interviewed and of these, eight were accepted.

Supplementing the overall professional recruiting program the Personnel Branch conducted recruiting interviews with students in the Co-operative Engineering Course at the University of Waterloo as part of a professional development program. In this university program, students pursue studies for four months and work for four months alternately. Although only one co-operative student employee was registered at the beginning of the year, before the end of the year 11 engineering students had contracted to complete four months' work between university sessions.

Programs such as the Great Lakes Survey, the River Basin Survey and the Northern Ontario Water Resources Survey posed some new demands for skills, training and experiences not previously required in recruitment of technical staff.

The prospect of staffing new provincial works such as the Lake Huron Water Supply System and the expansion which occurred at some municipal projects accounted for some new demands.

The keen public interest in water resources management has caught the imagination of young engineers, scientists and technologists. They are attracted to an organization that is in the public eye, and seek participation in worthwhile achievement. As a result, staff turnover in the professional and technical classes is low.

In keeping with the policy of staff development, the Commission has two well-defined programs administered by the Personnel Branch:

- (a) Sponsored postgraduate training for selected professionals.
- (b) Financial assistance for approved supplementary courses in administration, science and technology.

In the former program, 16 staff members were sponsored by the Commission or by National Health Grants Bursaries. These included engineers and scientific personnel pursuing graduate degrees in biology, hydrology and sanitary engineering, each involving a leave of absence for at least one full university term. This program is used to encourage upgrading present training or skills by attending university extension or technical courses.

The past year was the first full calendar year for OWRC staff participation in the Ontario Employees Group Insurance Plan. The plan has been generally well received. Analysis of participation in the optional features of the group plan indicates participation by 85 per cent of the staff.

During the past year four retirements were recorded. Two of these were long-service employees who began employment first with the Department of Health, and then transferred to the OWRC on its inception in 1957.

Experience gained in January and February during the university recruitment program indicated that an earlier start for recruitment of the 1967 graduates was necessary. Accordingly, planning commenced in May and the program got underway on October 12, 1966. Publicity material was furnished to the placement offices of 19 universities and five institutes of technology. With the program beyond the halfway mark, 14 institutions had been visited in eight provinces with an encouraging response. At the end of December, 177 candidates had been interviewed. Some offers of employment were made and already some acceptances have been received.

On December 31 the staff complement of the Commission was:

HEAD OFFICE ORGANIZATION

Permanent and Temporary	548
Casual and Seasonal Casual	35

PLANT OPERATIONS

Regular full-time	222
Regular part-time	17
Casual	19

Systems & E.D.P. Branch

E. V. SANDERS *Systems & Procedures Officer*

A study was conducted to consolidate the functions of purchasing, inventory control and stores under one head. Subsequently a study of the newly formed Supply Branch was commenced and certain recommendations were made to assist the Procurement Officer in carrying out his responsibilities. The findings of this report are still being discussed; however, many of the recommendations contained therein have been approved.

Early in 1966 the Government of Ontario established a Records Branch and employed the services of H. M. Records Services, Limited, to conduct a government-wide records management study. As O & M Services had been requested by the Commission to conduct a Records Management Study for it, O & M Services recommended that H. M. Records Services carry out this study in accordance with its terms of reference. Working closely with this Branch, H. M. Records Services has made certain recommendations to management.

Negotiations have been carried on with the Department of Public Works for additional Head Office space, laboratory space, and storage facilities.

With regard to the laboratories operation, negotiations are underway to have internal renovations to the present building carried out, and extensions to the existing building are being discussed.

Negotiations are also underway with the Department of Public Works to provide the Commission with additional storage facilities at the laboratories location.

A Data Processing Feasibility Study was completed and accepted. The Branch commenced testing and training existing staff to become Data Processing programmers. It was decided to recruit E.D.P complement as much as possible from within the

Commission. As a result of this decision, aptitude tests were given. Staff have completed the training course and Commission systems are now being developed.

Early in the year a request was made to set up a program to process, automatically, the data to be recovered as a result of the Great Lakes Pollution Survey Program. In order to accomplish this in the period of time remaining prior to the commencement of the program, visits were made to a number of installations currently active in this field. From these visits, many months of work were bypassed and a system was established by which the data could be gathered and converted to a computer facility.

Toward the end of 1966 the Branch was actively developing programs that would retrieve the data stored in a manner that would be meaningful to the Water Quality Surveys Branch of the Division of Sanitary Engineering.

Requests have been made to develop further programs related to the Great Lakes Survey, and it is hoped that these requests can be met early in 1967.

With the acceptance of the feasibility study, the Branch began writing equipment specifications in detail which will be submitted to all potential suppliers of Data Processing equipment. A decision was reached that the Commission would link its own system to the system in operation at the Department of Highways. This decision came about as a result of a government-wide study of Data Processing facilities in which it was recommended that the main information centre for engineering and technically-oriented operations would be the Department of Highways. In doing this, the Commission, in addition to its own facilities, will have access to a large and sophisticated computer facility, plus a staff of highly trained personnel when required.

As the basic purpose of the Branch is to provide service to the operating divisions of the Commission, consideration is being given to an educational program that will give both management and staff a better understanding of what Data Processing can and will do for the Commission.

Supply Branch

A. NORTH *Procurement Officer*

In the Shipping and Receiving Section stores workload during the course of the year was more evenly distributed by arranging for earlier pick-up of water samples from the rail depot; this also enabled the laboratory staff to complete a higher daily rate of analyses. In addition to water samples, receiving staff handled an increase of about 29 per cent over 1965 in other shipments.

Payments for Express Shipping and receiving charges on water samples increased by about 65 per cent, and this was due to an increase in the volume of shipments from Northern Ontario and the Great Lakes summer program.

Sample bottle shipments increased by 1,300 over the number shipped in 1965, and various plastic shipping bags were tested.

Chemicals with a high turnover rate have been placed on a blanket-order purchase system. To supply the London laboratory, several new chemicals have been added to stock.

A completely revised stationery catalogue was produced in conjunction with the Bay Street stockroom to standardize procedure in both areas and to facilitate speedy transfer of stock between stores when required.

The Main Stockroom is the area accounting for the bulk of a 54 per cent increase in stores activities for the period 1963-1966.

Small Equipment and Linen Stores has expanded considerably because of the requirements of the vessels "Pelican" and "Lac Vancouver" which have been performing surveys on the Great Lakes for the Water Quality Survey Branch.

Purchase Orders issued in the 1966 calendar year on Ordinary Vote numbered 4,368, as compared with 3,447 for 1965.

Equipment and materials value processed in the 1966 fiscal year on Ordinary Vote will approximate \$1,101,000 as compared with \$663,836 for 1965.

Division of Construction

A. W. SHATTUCK, *Director* J. C. F. MacDONALD, *Assistant Director*

During 1966 the Commission entered into 35 contracts valued at \$11,276,293 of which \$7,143,252 was for water works and \$4,143,041 was for sewage works.

During the year 29 contracts were completed. These had a total value of \$12,044,422 and consisted of 11 water works totaling \$8,195,807 and 18 sewage works at \$3,848,615.

SUMMARY OF PROJECTS

Bancroft (66-S-207)

DESCRIPTION OF PROJECT :	4180 lin. ft. of sanitary sewers 8" and 10" diameter as extensions to the existing system.
CONSULTING ENGINEERS :	McAlpine and Bews, Bancroft.
EXPECTED COMPLETION DATE :	May 30, 1967.
ESTIMATED PROJECT COST :	\$55,000.

Work commenced on November 18, 1966 and was approximately 60 per cent completed by the end of the year.

Black River (64-S-168)

DESCRIPTION OF PROJECT :	Sanitary sewers and lagoon.
CONSULTING ENGINEERS :	Sutcliffe Co., New Liskeard.
EXPECTED COMPLETION DATE :	September 30, 1967.
ESTIMATED PROJECT COST :	\$80,000.

Tenders were re-called and were opened on May 12th. The lowest tender was submitted by Leo Alarie & Sons Ltd. to whom the contract was awarded in September 1966. It was agreed that the order to start work would not be given before June 1, 1967.

Bobcaygeon (65-W-141 & WP-66-6)

DESCRIPTION OF PROJECT	Water distribution system.
65-w-141:	Final contract cost — \$249,209.

DESCRIPTION OF PROJECT	Water treatment plant and intake.
WP-66-6:	Est. contract cost — \$186,000.
CONSULTING ENGINEERS :	Canadian-Mitchell Associates Ltd., Bramalea.
COMPLETED :	Project 65-w-141 — October, 1966.
ESTIMATED COST OF BOTH PROJECTS:	\$500,000.

Tenders for both parts of the works were received in January 1966, but only one tender was submitted for the water treatment plant, and it was too high to be accepted. Work proceeded on the water distribution part of the works only, and arrangements were made to finance the treatment plant as a provincially-owned project. It is expected that tenders for the treatment plant will be re-called in 1967.

Brampton (66-W-155)

DESCRIPTION OF PROJECT:	
CONTRACT 1 — Watermains and pumping station. Final contract cost — \$206,520.	
CONTRACT 2 — 5.0 M.G.D. reservoir and valve house. Est. contract cost — \$437,584.	
CONSULTING ENGINEERS:	W. O. Chisholm & Associates Ltd., Scarborough.
COMPLETED:	
CONTRACT 1 — September, 1966.	
CONTRACT 2 — December, 1966.	
ESTIMATED PROJECT COST: \$835,000.	

Contract #1 was begun in April and completed in September with the watermains and pumping station being connected to the water supply from the Township of Toronto.

Contract #2 was started on June 21, 1966, and the reservoir was placed in service on November 25, 1966.



Intake construction for Lake Huron Water Supply System was climaxed with placing a 92-ton crib. Nearly 12,000 gallons of water were needed to sink the structure which rests at end of 8,000-foot intake line north of Grand Bend.

Brampton/Chinguacousy (65-S-184)**DESCRIPTION OF PROJECT:**

3.0 M.G.D. extension to sewage treatment plant.

CONSULTING ENGINEERS:

Proctor & Redfern, Toronto.

EXPECTED COMPLETION DATE:

January, 1967.

ESTIMATED PROJECT COST:

\$1,512,750.

Work on the extensions started in September 1965 and was scheduled to be completed in October 1966. The contractor was granted an extension of time for completion until December 24, 1966, but was unable to meet the extended completion date.

It is now expected that the plant extensions will be placed in operation in the latter part of January 1967.

Brighton (65-S-193)**DESCRIPTION OF PROJECT:**

8100 lin. ft. of sanitary sewer extensions to the existing sewer system.

CONSULTING ENGINEERS:

J. D. Lee & Co. Ltd., Kingston.

COMPLETED:

November 8, 1966.

FINAL PROJECT COST:

\$146,591.

Work on this project commenced on April 4, 1966, and was completed and in operation by November 8, 1966.

Cache Bay (63-W-121)**DESCRIPTION OF PROJECT:**

Construction of intake from Tanner Lake, feeder main, chlorination station, watermains and service connections.

CONSULTING ENGINEER:

R. S. MacLennan, North Bay.

EXPECTED COMPLETION DATE:

June 1967.

ESTIMATED PROJECT COST:

\$250,000.

Work on this project started on November 9, 1966. By the end of the year all watermains in the town had been laid, and 25 per cent of the service connections had been completed.

Chatham (62-S-102 & 65-S-186)**DESCRIPTION OF PROJECT:**

CONTRACT 1 – Sewage treatment plant. Final contract cost – \$1,479,430.

CONTRACT 2 – North Side interceptor sewers, force main and one pumping station. Final contract cost – \$197,682.

CONTRACT 3 – North Side interceptor sewers, force main and two pumping stations. Final contract cost – \$360,420.

CONTRACT 4 – South Side interceptor sewers, force main and two pumping stations. Final contract cost – \$554,079.

CONTRACT 5 – King Street interceptor sewer. Final contract cost – \$344,410.

CONTRACT 6 – Outlet sewer from Merritt Ave. to sewage treatment plant. Final contract cost – \$199,065.

CONTRACT 7 – Trunk sanitary sewer (Richmond St.). Est. contract cost – \$558,160.

CONTRACT 8 – Trunk sanitary sewer (Park Ave.). Est. contract cost – \$483,200.

CONTRACT 9 – Merritt Ave. pumping station. Final contract cost – \$217,865.

CONTRACT 10 – Park Ave. pumping station. Est. contract cost – \$92,300.

CONTRACT 11 – Aerated lagoon – industrial waste. Est. contract cost – \$444,000.

CONSULTING ENGINEERS:

Todgham & Case Ltd., Chatham. Gore & Storrie Ltd., Toronto.

CONSULTING ENGINEERS: R. V. Anderson Associates Ltd.,
Toronto.
COMPLETED: September 9, 1966.
FINAL PROJECT COST: \$79,851.

Work on this project commenced on March 8, 1966 and was completed and in operation on September 9, 1966.

Englehart (63-S-152)

DESCRIPTION OF PROJECT: Pumping station, force main, inlet and outlet structures and lagoons.
CONSULTING ENGINEERS: Sutcliffe Company, New Liskeard.
COMPLETED: September 1966.
ESTIMATED PROJECT COST: \$106,272.

Fort William (64-S-175)

DESCRIPTION OF PROJECT: Hardisty St. interceptor sewer (3900 lin. ft. of 54" diameter sewer in tunnel).
CONSULTING ENGINEERS: W. L. Wardrop & Assoc. Ltd., Winnipeg.
EXPECTED COMPLETION DATE: February 15, 1967.
ESTIMATED PROJECT COST: \$956,896.

The project was 88 per cent completed by the end of the year. A shortage of suitable labour slowed progress on the tunnel work during 1966. The remaining work consists of the construction of two reinforced concrete control chambers.

Grimsby (65-W-154)

DESCRIPTION OF PROJECT: 20-inch diameter watermain.
CONSULTING ENGINEERS: James F. MacLaren Ltd., Toronto.
COMPLETED: December 14, 1966.
ESTIMATED PROJECT COST: \$91,150.

Work was started on September 22, 1966, and completed on December 14, 1966. Minor restoration such as sodding and final clean-up will be completed in the spring of 1967.

Harriston (65-S-185)

DESCRIPTION OF PROJECT: Sanitary sewers (extension to sanitary sewer system constructed in 1964).
CONSULTING ENGINEERS: B. M. Ross and Associates Limited, Goderich.
COMPLETED: February 17, 1966.
ESTIMATED PROJECT COST: \$100,800.

Lake Erie Water Supply System (OWRC-WP-65-2)

DESCRIPTION OF PROJECT:
CONTRACT 1 – Shore protection and seawall. Est. contract cost – \$1,249,446.
CONTRACT 2 – 60" water intake and 36" plant drain. Est. contract cost – \$1,128,695.
CONTRACT 3 – Low lift pumping station at the lake. Est. contract cost – \$821,520.
CONTRACT 4 – Terminal reservoir at St. Thomas – 6 million gallon capacity. Est. contract cost – \$766,083.
CONTRACT 5 – Supplying, laying and jointing water pipe, specials and accessories for the 30" diameter pipeline from Lake Erie to St. Thomas. Est. contract cost – \$2,231,567.
CONTRACT 6 – Water treatment plant at Lake Erie. Est. contract cost – \$3,500,000.
CONTRACT 7 – Extension to St. Thomas existing pumping station. Est. contract cost – \$350,000.
CONTRACT 8 – Landscaping and painting at St. Thomas pumping station. Est. contract cost – \$30,000.

Mechanical and electrical equipment to be supplied by the Commission for the above contracts. Estimated cost – \$300,000.

CONSULTING ENGINEERS: James F. MacLaren Ltd., Toronto.
EXPECTED COMPLETION DATE:
CONTRACT 1 – January 1967. CONTRACT 4 – August 1967
CONTRACT 2 – August 1967. CONTRACT 5 – August 1967.
CONTRACT 3 – September 1967.

Tenders are expected to be called early in 1967 for Contracts 6 and 7.

Tenders for Contract 8 will probably not be called until early in 1968.

The excavation for the main cut at the lake shore started in July 1966 and was 90 per cent completed, and the access road to the low lift pumping station site was 80 per cent completed. At the low lift pumping station the excavation was completed, and the concrete plug at the bottom of the structure was poured.

Construction of the seawall was 60 per cent completed.

Work for the 60" intake started in June 1966 and 40 per cent had been completed by the end of the year.

Construction of the 6 million Imperial gallon terminal reservoir at St. Thomas started early in September 1966 and was 50 per cent completed by the end of the year.

Lake Huron Water Supply System (OWRC-WP-64-1)

DESCRIPTION OF PROJECT:

CONTRACT 1 – 72" dia. lake intake and 42" dia. plant drain. Est. contract cost – \$2,140,000.

CONTRACT 2 – Construction of low lift pumping station at Grand Bend. Est. contract cost – \$1,889,798.

CONTRACT 3 – Water treatment plant and high lift pumping station. Est. contract cost – \$5,485,589.

CONTRACT 4 – Supply and delivery of water pipes, specials and accessories. Final contract cost – \$4,364,535.

CONTRACT 5 – Laying and jointing water pipes, specials and accessories for 48" dia. pipeline. Est. contract cost – \$1,828,246.

CONTRACT 6 – Construction of terminal reservoir of 12 M.G.D. capacity. Est. contract cost – \$1,131,985.

CONTRACT 7 – Radio communication system. Est. contract cost – \$64,234.

CONTRACT 8 – Landscaping at Grand Bend. Est. contract cost – \$50,000.

CONTRACT 9 – Drain at reservoir. Est. contract cost – \$109,038.

CONSULTING ENGINEERS:

James F. MacLaren Ltd., Toronto.

COMPLETED:

CONTRACT 1 – December 23, 1966.

CONTRACT 4 – November 23, 1966.

CONTRACT 9 – December 1966.

EXPECTED COMPLETION DATE:

CONTRACT 2 – April 1967.

CONTRACT 6 – January 1967.

CONTRACT 3 – May 1967.

CONTRACT 7 – March 1967.

CONTRACT 5 – January 1967.

CONTRACT 8 – June 1967.

Estimated cost of construction and engineering – \$18,500,000.

Work on the intake and treatment plant drain which started early in September 1964 was completed by December 23, 1966. The structure for the low lift pumping station was completed and installation of mechanical and electrical equipment started. The structures for the treatment plant and high lift pumping station were also completed and installation of mechanical and electrical equipment was started. Two of the treated water pumps were installed.

The pipeline laying operation which started in August 1965 was completed by November 1966 and the entire line was successfully tested. Some mechanical work remained to be completed in the chambers at the end of the year.

The reservoir structure was also completed and the two cells and yard piping were successfully tested. Installation of electrical controls had started.

Work was also started both at the contractor's plant and at the site for the radio communication system.

The 30" dia. drain from the Arva Reservoir to the Medway Creek was also completed and successfully tested.

Listowel (64-S-174)

DESCRIPTION OF PROJECT:

Sanitary sewers (extensions to the town system by town forces).

COMPLETED: August 29, 1966.
ESTIMATED FINAL PROJECT COST: \$37,724.

Lucan (63-S-164 & 65-S-194)

DESCRIPTION OF PROJECT: Trunk sewers, service connections, prefabricated pumping station, force main and lagoon.
CONSULTING ENGINEERS: M. M. Dillon Ltd., London.
COMPLETED: January 10, 1966.
ESTIMATED PROJECT COST: \$160,766.

Work on these projects, which started in February 1965, was completed by January 10, 1966. Bad weather during the spring and fall of 1965 seriously hampered progress on this project.

A final inspection on this project was carried out in December 1966 and the contractor was instructed to attend to some deficiencies before the end of the normal maintenance period expiring January 10, 1967.

Metro. Toronto and Twp. of Toronto (63-S-160)

DESCRIPTION OF PROJECT: First extension to the Lakeview sewage treatment plant.
CONSULTING ENGINEERS: Gore & Storrie Ltd., Toronto.
EXPECTED COMPLETION DATE: May 1967.
ESTIMATED PROJECT COST: \$2,043,659.

Work started in January 1966 and during the year all structures were finished and some equipment was installed. The rest of the equipment will be installed early in 1967.

Twp. of Michipicoten (64-W-132)

DESCRIPTION OF PROJECT: Extension to water works system.
CONSULTING ENGINEERS: R. S. MacLennan, North Bay.
EXPECTED COMPLETION DATE: January 1967.
ESTIMATED PROJECT COST: \$258,387.

The intake and pipeline, pumping station and watermains were completed early in 1966. Delay in the delivery of some of the equipment set back completion of the works.

Milverton (64-S-166)

DESCRIPTION OF PROJECT: Sanitary sewers, one pumping station, force main and a one cell lagoon.
CONSULTING ENGINEERS: R. V. Anderson Associates Ltd., Toronto.
COMPLETED: December 15, 1966.
ESTIMATED PROJECT COST: \$348,996.

Work on this project commenced on December 1, 1965 and was completed by December 15, 1966 with the exception of asphalt reinstatement on the Main Street.

Moosonee (OWRC-WP-66-4 & OWRC-SP-66-2)

DESCRIPTION OF PROJECT: Sanitary sewerage system and sewage treatment plant.
Water works system including a water treatment plant.
Storm sewers.
Roads.
CONSULTING ENGINEERS: Sutcliffe Company, New Liskeard.
EXPECTED COMPLETION DATE: 1968.
ESTIMATED PROJECT COST: \$2,184,271.

Work started in September and due to heavy frost conditions the work on the pipelines stopped before Christmas and is to be resumed in April 1967. Sanitary sewers, storm sewers and watermains were installed on First Street.

Twp. of Mountjoy (65-S-195)

DESCRIPTION OF PROJECT: Sanitary sewers, service connections, force main and sewage pumping station.
CONSULTING ENGINEERS: Gore & Storrie Ltd., Toronto.
EXPECTED COMPLETION DATE: July 1967.
ESTIMATED PROJECT COST: \$157,964.

Sewers and sewer connections were 60 per cent completed by



Part of line from Grand Bend to Arva on Lake Huron system, this 48-inch pipe was last to be placed.

Busy scene is not site of modern pyramid but of lift pumping station to Lake Huron treatment plant.



the end of the year. The uncompleted work consists of the installation of the sewage pumping station and the force main.

Petrolia (64-S-178)

DESCRIPTION OF PROJECT: Sewers, pumping station, force main and lagoon.
CONSULTING ENGINEERS: M. M. Dillon Ltd., Windsor.
EXPECTED COMPLETION DATE: January 9, 1967.
ESTIMATED PROJECT COST: \$482,435.

The project was 97 per cent completed by the end of the year. Only minor surface restoration remained to be carried out in the spring of 1967.

Rockland (65-S-197)

DESCRIPTION OF PROJECT: 3048 lin. ft. of 8" dia. sanitary sewers as extensions to the existing sewer system.
CONSULTING ENGINEERS: J. L. Richards & Associates Ltd., Ottawa.
COMPLETED: December 1, 1966.
FINAL PROJECT COST: \$49,640.

The contractor commenced work on this project on April 14, 1966 and had the sewers in operation on October 3, 1966. The reinstatement of roads was completed by the end of November 1966.

Twp. of Saltfleet (65-S-191)

DESCRIPTION OF PROJECT: Extensions to sewer system.
CONSULTING ENGINEERS: Township Engineer, Township of Saltfleet.
COMPLETED: January 10, 1966.
FINAL PROJECT COST: \$35,250.

Work commenced on November 1, 1965, and was completed on January 10, 1966. The restoration of roads and other properties was completed in August.

Twp. of Saltfleet (Brentwood) (65-S-198)

DESCRIPTION OF PROJECT: Extensions to sewer system.
CONSULTING ENGINEERS: Township Engineer, Township of Saltfleet.
COMPLETED: June 30, 1966.
FINAL PROJECT COST: \$164,500.

Work commenced on the project on March 3, 1966, and the sewers were placed in service on June 30, 1966. The restoration of roads and other properties was completed in August.

Southampton (63-W-124)

DESCRIPTION OF PROJECT:
CONTRACT A – Trunk water main. Final contract cost – \$91,497.
CONTRACT B – Water intake and substructure of filtration building. Final contract cost – \$129,454.
CONTRACT C – Pumping station and filtration plant. Est. contract cost – \$160,565.
CONSULTING ENGINEERS: Philips & Roberts Ltd., Burlington.
COMPLETED: CONTRACT A – October 29, 1965.
CONTRACT B – December 4, 1965.
CONTRACT C – January 14, 1966.
ESTIMATED PROJECT COST: \$432,000.

Vankleek Hill (65-W-142)

DESCRIPTION OF PROJECT:
CONTRACT A – Two pumping stations one standpipe foundation and a water distribution system. Est. contract cost – \$300,167.
CONTRACT B – Supply and erection of a water storage standpipe for 500,000 Imp. Gal. Est. contract cost – \$57,187.
CONSULTING ENGINEERS: Canadian British Engineering Consultants, Toronto.
COMPLETED: CONTRACT A – December 5, 1966.
CONTRACT B – November 7, 1966.
ESTIMATED PROJECT COST: \$437,043.

Work on this project commenced on February 2, 1966, and was completed on December 5, 1966.

Wallaceburg (65-S-181)

DESCRIPTION OF PROJECT:

CONTRACT 1 – Trunk sanitary sewer (Gillard St.) . Final contract cost – \$128,750.

CONTRACT 2 – Trunk sanitary sewer. (Gillard and Wallace Sts.) . Est. contract cost – \$560,428.

CONTRACTS 3 & 4 – Sanitary sewers, pumping station and force main. Est. contract cost – \$450,000.

CONTRACT 5 – Sanitary sewers. Est. contract cost – \$352,200.

CONTRACT 6 – Sanitary sewers. Est. contract cost – \$312,575.

CONTRACT 7 – Sanitary sewers. Est. contract cost – \$304,050.

CONTRACT 8 – Sanitary sewers. Est. contract cost – \$323,150.

CONTRACT 9 – Sanitary sewers. Est. contract cost – \$185,600.

CONTRACT 10 – Sanitary sewers. Est. contract cost – \$213,100.

CONTRACT 11 – Sewage treatment plant. Est. contract cost – \$1,248,000.

CONSULTING ENGINEERS: Todgham & Case Ltd., Chatham.
Gore & Storrie Ltd., Toronto.

COMPLETED: CONTRACT 1 – June 28, 1966.

EXPECTED COMPLETION DATE: CONTRACT 2 – November 21, 1967.

ESTIMATED PROJECT COST: \$4,653,682.

CONTRACT 2 – The general contractor commenced construction on November 21, 1966, and had equipment on site and layout work started by the end of the year.

CONTRACTS 3 and 11 – Tenders to be called early in 1967.
CONTRACTS 4, 5, 6, 7, 8, 9 and 10 – Plans and specifications are being prepared by the consulting engineers.

Waterdown (66-S-213)

DESCRIPTION OF PROJECT: Extensions to sewer system.

CONSULTING ENGINEERS: Kilborn Engineering Ltd., Toronto.

COMPLETED: September 15, 1966.

ESTIMATED PROJECT COST: \$53,000.

Work was commenced in August and completed in September, ahead of schedule. The originally estimated project costs were not exceeded.

Twp. of Wicksteed (64-W-139)

DESCRIPTION OF PROJECT:

CONTRACT 1 – Watermains and service connections. Est. contract cost – \$216,922.

CONTRACT 2 – Steel water storage tank. Est. contract cost – \$18,690.

CONSULTING ENGINEERS: Kilborn Engineering Ltd.,
Toronto.

EXPECTED COMPLETION DATE: June 1967.

ESTIMATED PROJECT COST: \$254,000.

About 85 per cent of Contract No. 1 was completed by the end of the year. The steel for Contract No. 2 had been manufactured and was expected to be delivered to the site at the end of March 1967.

Winchester (64-S-137)

DESCRIPTION OF PROJECT: Well, pumphouse and watermain.

CONSULTING ENGINEERS: J. L. Richards & Assoc. Ltd.,
Ottawa.

EXPECTED COMPLETION DATE: June 1967.

ESTIMATED PROJECT COST: \$29,500.

The work was commenced during the second half of December 1966 and will be substantially completed in February 1967. The access road and the final grading of the site have to be left until the spring of 1967.

Division of Finance

D. A. JOYNT, *Director and Comptroller* E. F. HEATH, *Assistant Comptroller*

During the past year the Division of Finance continued to seek improvement in reporting methods, processing of suppliers accounts for payment, budgeting of expenditures, protection of Commission assets, and accountability to municipalities for funds held in trust and used, in part, in the operation of municipal water and sewage works.

ACCOUNTING

The work of the accounting area is best indicated by the following statistics which reflect an increase over the previous year.

(A) ORDINARY VOTE EXPENDITURES		(B) GROSS CAPITAL EXPENDITURES	
1964/65	\$ 3,114,742	1964/65	\$15,623,685
1965/66	\$ 4,141,335	1965/66	\$15,065,352
1966/67	\$ 6,300,000 (Est.)	1966/67	\$25,500,000 (Est.)

(C) GROSS CAPITAL RECEIPTS		PAYMENTS FROM MUNICIPALITIES C.M.H.C. AND OTHERS		TOTAL
	WINTER WORKS SUBSIDIES			
1964/65	\$1,452,838	\$6,771,250		\$8,224,088
1965/66	\$ 336,079	\$6,577,339		\$6,913,418
1966/67	\$ 654,900 (Est.)	\$4,345,100 (Est.)		\$5,000,000 (Est.)

EXPENDITURES IN THE OPERATION OF WATER AND SEWAGE TREATMENT PLANTS	
1964	\$2,548,350
1965	\$2,706,344
1966	\$3,006,232

RECEIPTS FROM BILLINGS TO MUNICIPALITIES					
	DEBT RETIREMENT	RESERVE FOR CONTINGENCIES	INTEREST	PROJECT OPERATION	TOTAL
1964	\$1,436,669	\$569,489	\$3,732,195	\$2,622,652	\$8,361,005
1965	\$1,605,775	\$644,651	\$3,914,297	\$2,858,197	\$9,022,920
1966	\$1,701,159	\$637,203	\$4,074,182	\$2,966,788	\$9,379,332

The funds received for the debt retirement and reserve for contingency charges were invested by the OWRC Investment Committee in accordance with the requirements of the OWRC Act. The interest money received from billings was used by the Commis-

sion to repay, in part, the liability of the OWRC for interest on funds borrowed from the Province, while the amount received for operations was used to pay the operating costs of each project.

At December 31, loans from the Province of Ontario for the purpose of constructing water and sewage projects totalled \$100,730,346, (\$81,908,691 for municipal projects and \$18,821,655 for provincial projects). The effective rate of interest payable to the Province on the total amount is 5.724 per cent or some \$5,765,516 per annum.

BUDGET

Owing to the increase of expenditures and the diversified activities of the Commission, budgetary control was elaborated to meet the responsible demands of the 13 separate programs of the Commission.

The internal classification of accounts, which set up accounts by type of expenditure for each program, was revised in order to maintain accurate costs by nature of expenditure and to assist in establishing future estimates and realistic cash forecasts.

The monthly budget and expenditure reports were prepared and directed to various levels of management to encompass the function of responsibility reporting and to ensure the accountability of expenditures. These reports reflected the progress of each program on a comparative basis of budget cost analysis.

INSURANCE

During the year, the Commission's All-Risk Insurance on the various plants was re-negotiated. The new policy covers all Commission plants and installations in one blanket amount of \$47,378,800, instead of having a separate policy for each project. Substantial rate reductions were also obtained which resulted in annual premium savings of \$12,500.

The Commission's Comprehensive General Liability Insurance was revised to give the broadest type of policy available, with substantially increased limits, for the better protection of all concerned.

Commission insurance on pressure vessels of all types was revised and is now written on a replacement cost basis with an increased limit of \$500,000. Re-negotiation of rates resulted in an annual saving of \$1,000.

INTERNAL AUDIT

The audit program carried out during the year to December 31, 1966, covered many aspects of the financial transactions of the Commission with particular emphasis on the revenues and expen-

diture of the municipal and provincial projects.

Internal controls were under continual review and, where necessary, action was taken or recommendations made to institute new controls or strengthen existing controls with a view to the further protection of the Commission's Assets.

Continued assistance was provided to municipalities by the staff of the Division in the installation of accounting and billing systems, and the instruction of municipal staff in the maintaining of records.

ONTARIO WATER RESOURCES COMMISSION

(constituted by Special Act of the Ontario Legislature)

BALANCE SHEET

As at December 31, 1966

ASSETS

CAPITAL ACCOUNT	
Cash in bank	\$ 903,640.61
Recoverable advances	55,368.33
Accounts receivable	1,966,114.09
Capital Assets	
Completed projects owned by Ontario Water Resources Commission	56,071,127.84
Capital advances for completed municipal projects	21,558,893.02
Construction in progress	29,989,173.03
Amounts due from reserve account	17,068.39
	<u>\$110,561,385.31</u>
RESERVE ACCOUNT	
Cash in bank	\$ 204,917.20
Accrued interest receivable	41,335.63
Investments (Market value \$2,672,717.50)	2,867,754.95
	<u>\$ 3,114,007.78</u>
DEBT RETIREMENT ACCOUNT	
Cash in bank	\$ 431,185.28
Accrued interest receivable	131,514.38
Investments (Market value \$7,788,425.00)	8,335,217.77
Amounts due from capital account	1,323.52
	<u>\$ 8,899,240.95</u>
	<u>\$122,574,634.04</u>

LIABILITIES

CAPITAL ACCOUNT	
Accounts payable and contract retentions	\$ 3,707,934.68
Advances from municipalities and others	
Operating and interest	\$1,113,029.87
Capital	<u>4,933,750.68</u>
	6,046,780.55
Due to Province of Ontario	
Treasury Department advance	75,000.00
Funded debt payable to Province of Ontario	100,730,346.56
Amounts due to debt retirement account	1,323.52
	<u>\$110,561,385.31</u>
RESERVE ACCOUNT	
Funds for renewals, replacements and contingencies under Section 43 of the Act	\$ 3,096,939.39
Amounts due to capital account	17,068.39
	<u>\$ 3,114,007.78</u>
DEBT RETIREMENT ACCOUNT	
Sinking fund for the recovery of the cost of capital assets at 3¼ % under Section 44 of the Act	\$ 8,899,240.95
	<u>\$ 8,899,240.95</u>
	<u>\$122,574,634.04</u>

NOTE: As at December 31, 1966, commitments had been made under final agreements executed for the construction of projects requiring additional gross expenditures of approximately \$30,000,000.

Division of Industrial Wastes

D. P. CAPLICE, *Director* H. A. CLARKE, *Assistant Director*

The Division of Industrial Wastes is responsible for the administration and regulatory function of the Commission in industrial waste control as set out in Sections 27, 31 and 50 of the OWRC Act. The Division is organized into three functional branches.

The Administration Branch directs and co-ordinates all the activities of the Division and provides the stenographic, typing, clerical and statistical services for the engineering branches.

The Field Services Branch (1) maintains a quality and quantity inventory of industrial waste disposal in Ontario; (2) investigates, on a regular basis, all industrial sources of water pollution and prepares engineering reports which form the basis for obtaining compliance with the terms of the OWRC Act for pollution control, and (3) assists municipalities and industries in waste control by providing a technical advisory service related to appraisal of new-industry locations or expansion of existing plants.

The Design Approvals and Special Projects Branch carries out the following functions: (1) the review of engineering plans for the collection, treatment, transmission and disposal of wastes from new or expanding industrial operations and the preparation of certificates of approval as required by Section 31 of the OWRC Act, (2) provides specialized technical appraisal of difficult waste treatment problems, and (3) carries out detailed industrial studies leading to the preparation of reports for certain types of industry on a province-wide basis.

SUMMARY OF FIELD ACTIVITIES

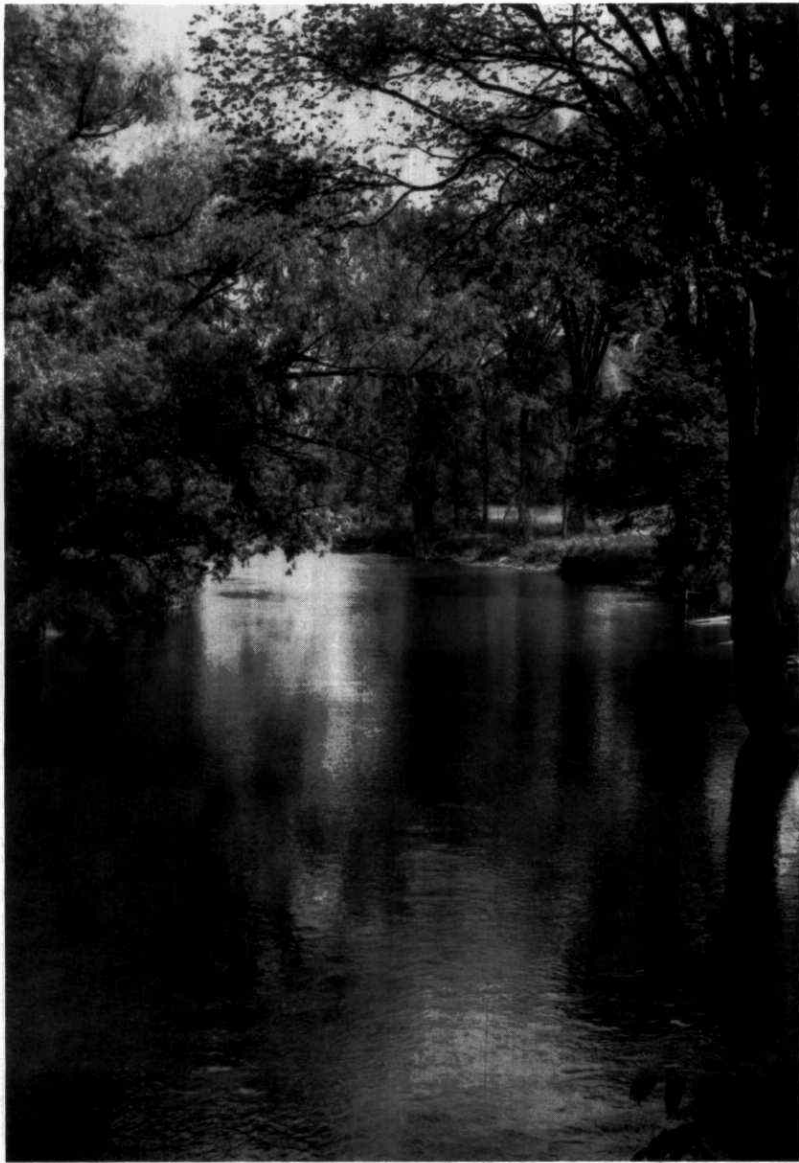
The distribution of field workload is shown in Table I. The increase for certain aspects of field coverage over 1965 is shown in the right hand column.

TABLE I

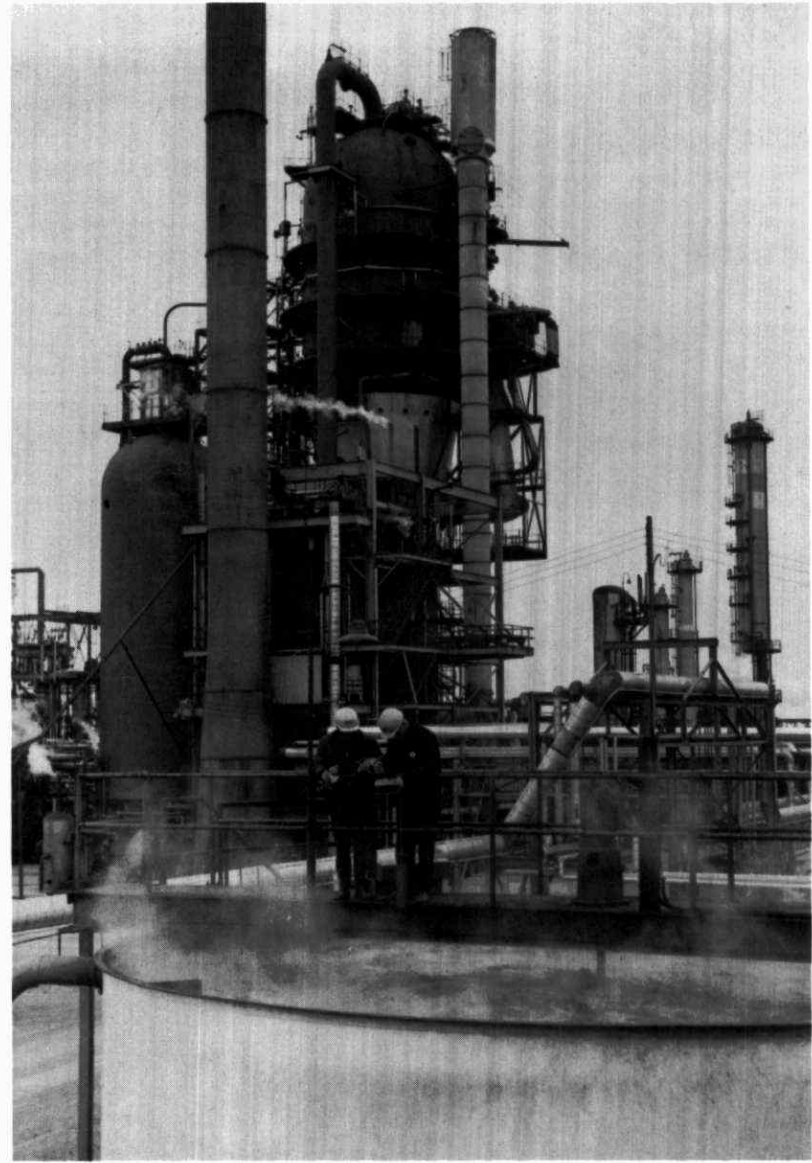
DISTRICTS	1	2	3	4	TOTAL	% INCREASE
Total Field Visits:						
1965	131	151	181	119	582	
1966	266	322	525	403	1516	160
Industry Surveys:						
1965	76	101	161	71	409	
1966	146	55	184	140	525	28.3
Municipal Surveys:						
1965	1	2	4	5	12	
1966	2	1	7	2	12	—
County or Area Surveys:						
1965	0	1	2	1	4	
1966	—	—	2	—	2	—
Reports Issued:						
1965	46	25	79	45	195	
1966	96	56	83	131	366	87.7
Meetings & Consultations with Industry or Municipalities:						
1965	30	45	38	44	157	
1966	41	39	84	45	209	37.3

Reports resulting from field surveys form the basis for subsequent action relating to the control and abatement of industrial pollution, and it is interesting to note the substantial increase in the output of reports. A large number of small secondary industries, particularly those in the dairy and cheese-making category, are located in Districts 3 and 4. Most of the large industrial water users, including a major portion of the chemical industry and basic steel industry, are located in the western districts of the Province, and this type of industry requires more detailed and extensive survey work.

It is also to be noted from Table I that an increased number of meetings were held during 1966 to establish time schedules for the planning, engineering and construction of treatment facilities. At such meetings the selection of the treatment process is based on a comparison of the analytical results obtained from survey work with the Commission's Objectives for Industrial Waste Control and Water Quality. In the case of wastes dis-



Lucid beauty of Credit River at Boston Mills
illustrates aim of Industrial Wastes Division.



Divisional staff carry out routine visits to
help industry develop waste control programs.

charged to sewerage systems, schedules of waste control adopted by municipalities are used.

As in 1965, twelve municipal surveys were completed. A total of 85 industries were surveyed in this aspect of the Division's work in Port Dover, Glencoe, Barrie, Orillia, Oakville, Lindsay, Port Hope, North Bay, Midland, Bradford, Cornwall and Almonte.

STATUS OF CONTROL IN THE MAJOR INDUSTRIES

(a) Pulp and Paper

Substantial progress was made during the year toward the objectives for waste control that were placed before the pulp and paper industry in 1965. Although the industry has long been a major contributor to water pollution, it is now moving forward with large-scale measures involving both in-plant improvement and the addition of waste treatment works beyond the production processes. Because of the size and complexity of the problems to be dealt with by the industry, programming of many of the works over a period of time has been found to be necessary.

Nine mills now have satisfactory waste treatment or control, either through access to municipal sewage treatment works or by the installation of separate treatment systems. Two mills in Toronto are negotiating for connection to municipal sewers early in 1967. Twenty-three others have submitted proposals, primarily for the removal of bark and fibre solids, at an estimated cost of approximately \$20 million. It is to be noted that a number of the measures proposed serve the twofold purpose of increasing mill operation efficiencies and significantly reducing waste loading. Ten applications for approval of engineering plans were received, with an estimated cost of \$4 million.

Field studies were carried out by Commission staff throughout the industry as part of a program of continuing surveillance. These surveys indicated that recent mill expansions in the industry have not appreciably added to the total waste loading from the industry. Waste-control measures now underway will further reduce the suspended-solids discharge from the industry by 20

per cent in 1967 and 50 per cent in 1968. Treatment of the waste flows by biological processes or other methods will form the basis for further control beyond that date. All companies have been requested to present engineering proposals to meet the Commission's objective for the installation of secondary treatment or control facilities by the end of 1970.

(b) Chemical and Petroleum

During 1966, industries in this category continued to develop waste control programs to meet the Commission's objectives for industrial wastes control. All companies that planned or brought new facilities into production presented plans for treatment and control of waste discharges. Included were submissions by Canadian Industries Limited, Shell Canada Limited, and Imperial Oil Enterprises for plants located in Sarnia, and by Cornwall Chemicals Limited for a new manufacturing facility in Cornwall.

A positive approach was taken by Polymer Corporation, Sarnia, in developing a treatment program for reduction of fine polymeric solids and phenol concentrations in the plant effluents.

Allied Chemical Canada Limited constructed settling ponds at its Amherstburg soda ash plant which reduced the suspended solids load discharged to the Detroit River by 70 per cent.

Union Carbide Canada Limited, Belleville, has proposed a treatment program, to be implemented during 1967, for the segregation and incineration of strong phenolic wastes resulting from the manufacture of phenol-formaldehyde resins.

As in previous years, surveys were carried out at all large chemical plants to ensure that the waste treatment units in operation throughout the industry were being properly operated and maintained. Monthly waste analysis reports continue to be submitted to the Division by the industries located in the Sarnia-St. Clair River area and along the Lake Ontario waterfront.

(c) Steel

In 1966 the steel industry in Ontario invested heavily in water pollution abatement measures. Over \$4.6 million was allocated to Commission-approved works, and several million dollars were

allocated for treatment facilities and control measures to be installed or effected in 1967.

Dominion Foundries and Steel at Hamilton allocated some \$3.7 million for waste treatment. By the end of the year, this company had under construction a phenol destruction unit, an ammonium sulphate by-product plant, an iron-fines recovery plant and a hydrogen sulphide and cyanide removal plant. These installations will result in substantial reductions in waste loadings to Hamilton Bay. Five tons per day of ammonia and 120 tons of fine solids will be removed. Phenol losses will be practically eliminated and toxic cyanides and sulphides will be removed from the effluent. Dofasco has also presented proposals to the Commission for the further reduction of oil contamination and the treatment of spent pickle liquor. These control measures are to be engineered and put under construction during 1967.

Algoma Steel at Sault Ste. Marie placed orders for a phenol recovery plant at an estimated cost of \$900,000. This unit will be completed in 1967 and its operation will greatly reduce the quantity of phenols discharged in the mill effluents. Algoma has dealt vigorously with the problem of waste oils. Separators, traps, etc., have been installed at the production units – the sources of oil losses – and these have effected a significant reduction in oil losses to the St. Mary River.

At the Steel Company of Canada Limited, the ancillary acid regeneration plant to the hydrochloric acid pickling process, introduced in 1965, came into operation. No spent pickle liquor is produced in these new processes. The acid is recovered for re-use together with the iron dissolved in the process. On the basis of the experience gained during the year, the company has decided to convert another of its two remaining pickle lines to the hydrochloric acid process. When this has been done, spent pickle liquor wastes will be essentially eliminated and the waste loadings to Hamilton Bay greatly reduced. Other equipment was installed to recover materials from the coking plant and rolling mill operations.

On the whole, this industry has demonstrated a genuine willingness to co-operate with the Commission in the attainment of the objectives for the control of industrial waste discharges to the surface waters of the Province.

(d) Mining

The large-scale development of base-metal mining operations has been a recent highlight of industrial growth in Ontario. Staff of the Division worked in close co-operation with the Department of Mines and with management and technical personnel in the industry to ensure that waste controls were undertaken at all new mining sites in keeping with guidelines that were prepared in 1965. Proposals were accordingly received for waste handling at the Timagami and Red Lake iron ore developments and for the operation of a copper-zinc mine in Kidd Township near Timmins. Pre-operational control was assured in each case.

Studies in the Sudbury area have been followed by close consultation with representatives of both the International Nickel Company of Canada, Limited, and Falconbridge Nickel Mines, Limited. Both companies are engaged in expansion programs in which plans for improved waste control at existing and new facilities form an integral part of new mine development. Preliminary survey work was carried out in the established mining areas of Timmins, Cobalt and Kirkland Lake with a view to defining the limitations on existing disposal procedures.

All operating uranium mines were surveyed during the year. Treatment with barium chloride for the removal of radium was being practised in all cases. At the year end, a status report on all operating and non-operating uranium mines in the Province was being prepared with a view to developing effective long-term control measures, particularly at those mines which may be brought back into production in the near future.

WASTE CONTROL

IN THE SMALL AND SECONDARY INDUSTRIES

Much of the cheese and milk production in the Province is carried on in small plants. The operation of these plants is subject

to seasonal variations which make methods of waste treatment more costly. In most cases the rural locations permit the use of some form of disposal on the land in summer. This is usually satisfactory, providing the operation is properly managed and equipment maintained. However, in the winter months it is necessary to impound the wastes until the spring when these can be disposed of in the usual manner. The companies are being encouraged to adopt this procedure and regular examinations are made by the field staff to ensure that pollution of watercourses does not occur.

There are a large number of small slaughterhouses and meat-processing plants in the Province; however, they account for only about ten per cent of the meat production in Ontario. For the most part they are engaged in custom killing and small butcher operations. The smaller plants use septic tanks and tile beds and these generally prove to be adequate. However, some of the larger operations in rural areas employ lagoons for the treatment of the process wastes. Here again, continual surveillance is maintained to prevent or eliminate polluting discharges.

Poultry killing and processing presents similar problems, although production is on a larger scale, and eleven of the largest operations are located in municipalities where sewage treatment is available. At Imperial Foods, Limited, Watford, an aerated basin, followed by a conventional waste stabilization pond, is used to treat the plant wastes with good results. Ten plants in the Province provide their own treatment in conventional stabilization ponds or aerated lagoons.

In December an aerated lagoon was put into operation in the Township of Winchester by Nestle (Canada) Limited to treat wastes arising from the manufacture of dairy and food products. It is expected that this installation will eliminate the rather substantial waste loadings to the South Nation River. The efficiency of the process will be carefully evaluated in 1967.

In general, food processing operations produce strong wastes which are best treated in municipal sewage treatment plants and,

where possible, the Commission recommends this method of disposal. However, acceptance of the wastes is usually predicated on a certain degree of pretreatment and the capability of the sewage treatment plant to handle the loading. A number of outstanding pollution problems in small municipalities were resolved in 1966 by re-directing wastes from industries to sanitary sewer systems.

Activity relating to the control of toxic wastes from the metal-finishing and plating industries was stepped up and a number of situations were brought under control. Routine surveillance is required to maintain adequate waste control in these industries.

It is estimated that greater than 50 per cent of the total industrial waste flow in the Province is discharged to municipal sewers for treatment in combination with domestic sewage. Therefore there is a considerable investment on the part of municipalities in industrial waste treatment, with industry contributing through municipal taxes or sewer-use charges. The importance of this form of disposal to over-all pollution control in the Province is evidenced by the fact that some 600 industries, in a range of categories, discharge wastes to municipal sewage systems constructed by the Commission since 1957.

To control and regulate the discharge of wastes from industry, it is recommended that municipalities enact sewer-use by-laws and Commission staff continue to advise and guide municipalities considering the enactment of such by-laws. The practice of charging industry for treatment of high-strength wastes which do not conform to by-law limits is becoming more prevalent.

A province-wide survey of municipal sewer-use by-laws was underway at the year end. The results of this study, in conjunction with information obtained from a literature survey, will be used to improve the present OWRC guide prepared for municipalities considering the adoption of sewer-use regulations.

DESIGN APPROVALS AND SPECIAL PROJECTS

(A) Design Approvals

Control of industrial waste disposal is regulated through the implementation of Section 31 of the OWRC Act, which requires in-

dustry to submit applications to the Commission for approval of plans for the collection, transmission, treatment and disposal of industrial wastes. Applications are reviewed and, if found satisfactory, certificates of approval are issued in the same manner as for sewage works.

Table II summarizes the work for 1966. Forty-eight certificates of approval were issued for the installation of works costing some \$10,600,000. Twelve applications were received for works costing some \$760,000 which were under construction or were considered as in-plant recovery and for which approval certificates were not issued but concurrence given. Twenty-four further applications for works estimated to cost some \$5,660,000 were received during 1966, which were either in abeyance or under review at the year end and the processing of which was to be completed in 1967.

Before approval certificates are issued, consideration is given to the holding of public hearings according to Section 32 of the Act. One such hearing was held in the Town of Timagami on the application of Cliffs of Canada, Limited, for the installation of tailings impoundment facilities to serve the proposed new Sherman Mine in the District of Nipissing.

TABLE II
Summary of Projects for 1966

APPLICATIONS RECEIVED	86
CERTIFICATES OF APPROVAL ISSUED	48
PRELIMINARY CERTIFICATES OF APPROVAL ISSUED	2
APPLICATIONS REVIEWED — CONCURRENCE GIVEN	12
APPLICATIONS REVIEWED — APPROVAL NOT ISSUED	5
APPLICATIONS UNDER REVIEW	20
APPLICATIONS HELD IN ABEYANCE	4
PROJECT MEETINGS	66
TOTAL ESTIMATED CAPITAL EXPENDITURE INVOLVED IN CERTIFICATES OF APPROVAL ISSUED IN 1966	\$10,644,900 (48)

(B) Special Projects

Special projects, undertaken in 1966, included:

(1) the preparation of detailed reports on pollution problems related to the operation of the municipal sewage plants and run-off from abandoned industrial sites or dumps,

(2) technical advice and guidance in the preparation of orders issued under Section 50 of the Act and participation in the collection of evidence and subsequent laying of charges under Section 27, and

(3) evaluation of potential industrial waste loadings in municipalities where sewage works projects are being developed.

An industry located in the Township of Foley near Parry Sound was prosecuted under Section 27 (1) of the Act and found guilty. Another charge against a manufacturing firm under Section 27 (1) had not yet come to trial, and authorization to proceed with action in yet another case was received from the Commission at the year end.

Under Section 50 of the Act, orders in the form of requirements and directions were served on five industries. In each case the industry concerned was required either to construct treatment facilities or to make investigations and submit reports to the Commission relating to the collection, transmission and treatment of industrial wastes.

One injunction under Section 26 of the Act was obtained during the year against a mining firm located north of Sault Ste. Marie. When the company indicated that immediate measures and studies would be undertaken to correct the pollution problem, the injunction was withdrawn.

In addition, extensive reports were prepared on the status of pollution control in the pulp and paper industry and on land disposal of industrial wastes in the metropolitan area of Toronto. At the year's end, a report on waste disposal at the operating and non-operating uranium mines in the Province was being prepared with a view to suggesting improvements in waste control at the mine sites.

During the year, a province-wide survey of municipal sewer-use by-laws was started. It is hoped that this study will permit an improved schedule of controls to be prepared which will serve as a guide to municipalities considering revision or enactment of by-laws.

Division of Laboratories

J. H. NEIL, *Director*

A major increase in the work of the four branches of the Division was achieved in 1966. Table I compares the number of samples handled and the determinations made by each branch in 1965 and 1966. While 16.4 per cent more samples were received by the laboratory, 44.1 per cent more analyses were performed on them. Approximately 30 per cent of samples received were submitted from sources outside the Commission.

Figure I demonstrates the growth in work load from 1956 to 1966. In this period the samples received by the laboratory have increased from about 6,000 to 79,000 per year.

Probably the most significant development in the past year has been the expanded Great Lakes Program. All Branches have been involved in various aspects of this work. The routine analyses for chemical and bacteriological work have been organized by the respective branches under a single co-ordinator in charge of both the London and Toronto laboratories. The Biology Branch established a program relating to the biology of the near-shore waters. Special chemical studies using carbon filters to extract minute quantities of organic chemicals from Great Lakes waters are also in operation. Filters are presently extracting samples from Lake Huron, the lower St. Clair River and Lake Erie, and a fourth sampler will shortly go into operation in Lake Ontario. When the current analyses are completed on the biological and carbon extract samples, they will be preserved and catalogued for future reference in accordance with good scientific practice.

The first year of a three-year study of the water conditions in the uranium mining areas of Elliot Lake and Bancroft was completed. Several Divisions of the Commission are working on this investigation with the laboratory being responsible for the biological evaluation and the analyses of chemical samples.

The work carried out by the laboratory has always held considerable public appeal. For this reason many requests for tours of the laboratory and for lectures on the measurement of pollution are received. University classes from biology, bacteriology and public health courses visited the laboratory last year. A number of other groups from technical schools and some enrichment classes also visited the laboratory. Another function of an educative nature has been the participation of divisional staff in the Water and Sewage Plant Operators' courses given at the laboratory.

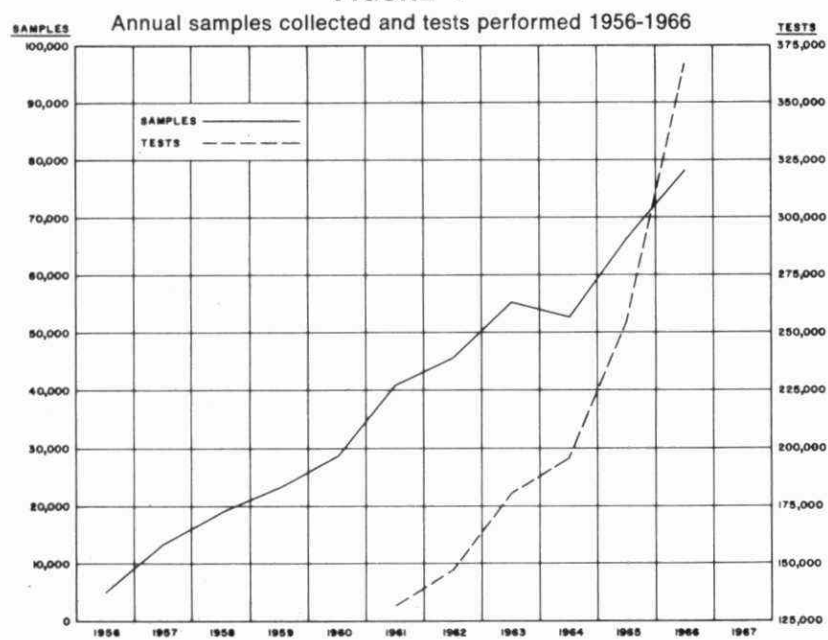
The laboratory contributed to the Exhibition booth by establishing an operating chemical laboratory and by developing an aquarium display of life in clean water and life in polluted water.

With the major increases in samples received by the laboratory, continuing studies must develop new methods of analyses which are accurate yet faster and less expensive to perform. Good progress has been made in this regard as indicated by the fact that there has been no increase in cost per determination for analyses performed in the routine chemical laboratory. Evaluation of equipment designed to automate analyses has been completed and a number of the high volume determinations will be transferred to this equipment when it is purchased in 1967.

TABLE I

	No. of Samples			No. of Determinations		
	1965	1966		1965	1966	
Bacteriology	29,647	32,252	+ 8.8%	43,205	76,525	+76.7%
Biology	2,069	3,260	+60.0%	2,447	2,898	+18.0%
Chemistry, Total	35,689	43,140	+21.0%	211,043	290,367	+36.9%
Chemistry I	—	—		(199,462)	(276,779)	+38.6%
Chemistry II	—	—		(11,581)	(13,588)	+17.3%
Total	67,405	78,652	+16.4%	256,695	369,790	+44.1%

FIGURE 1



Actual figures for above graph (Fig. I)

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
Samples	5,915	13,212	19,600	23,351	29,296	40,126	45,985	55,597	52,056	67,405	78,652
Tests	—	—	—	—	—	130,151	149,038	181,680	196,918	256,695	369,790



Technician in Industrial Wastes laboratory performs analysis on one of 78,000 samples collected in 1966.

Bacteriology Branch

Various improvements in the Membrane Filter (MF) procedure were made in 1966 to handle the large numbers of samples and to introduce automatic devices wherever possible in the analytical train. The comparative evaluation of the MF procedure and an alternative "Presence-Absence" (P-A) test for detecting coliform bacteria in municipal drinking water supplies was extensively investigated. A study was made to determine the relationship between coliform counts, "background counts" on coliform plates and total bacterial counts of drinking water samples. The developments were instituted to decrease the required quantities of laboratory materials and the preparation time for supplies, to increase sensitivity of tests and to allow for more attention to be given each series of samples.

Bacteriological facilities for examination of Great Lakes samples were installed in Toronto and London and, for part of the summer, on the vessel "M.V. Sparks". Coliform analyses represented the major portion of this work load, and total bacterial counts performed on many samples provided additional information on water quality. A comprehensive review of marine and fresh-water studies was made to obtain an appreciation of sampling technique, cultural methods of analysis and microbiological parameters used in eutrophication studies.

The Toronto and London field laboratories were examined to determine the influence of contaminating air-borne microorganisms on the results of total bacterial plate counts. The use of a 24-hour delayed analytical procedure was examined for uniformity in conducting the Great Lakes work. Programs were developed for the computer processing of total coliform and total bacterial counts on the Great Lakes sample results. These data were to form the basis of future studies of the Great Lakes.

Experiments were performed to assess the use of ultra-violet

light and chlorine dioxide for disinfecting drinking water. Two detergents were also examined for their effectiveness as disinfectants. Several requests were received to characterize the bacterial flora of water samples in instances where suspected contamination of the water was considered to have caused problems in a fish hatchery, at a skiing resort and at a cheese factory. These requests required the use of special diagnostic procedures to permit isolation and identification of representative microorganisms.

A field trip was made to the Parry Sound WPCP to investigate disinfection practices of the final effluent and variability in bacteriological results of effluent samples. A joint survey of the Mount Forest water supply, by members of the Division of Sanitary Engineering and the Environmental Health Branch of the Department of Health, permitted parallel bacteriological examination of samples in the Central Laboratory and the OWRC Laboratory to determine the source of aberrant results apparent in the water quality.

A potato-processing plant at Alliston was visited to observe the unusual pinkish-red colour of the stabilization lagoons. Subsequent laboratory examination showed coccus forms of bacteria as the probable cause of this phenomenon. These bacteria were members of the red and purple, photosynthetic, sulfur group which developed in the presence of light and anaerobic conditions.

An investigation of the iron-removal and filter clogging problem experienced in the Township of Vaughan Concord plant indicated that bacterial slimes and the growth of iron bacteria were likely contributing to operating difficulties in this plant.

Tours, lectures and laboratory demonstrations were arranged for several groups. Information pertaining to bacteriological procedures, interpretation of bacteriological results, methods of disinfecting well water supplies, and water quality objectives was distributed on request.

A project to develop a photographic reference collection of coliform sheen colonies was started. An attempt was made to cor-



In Bacteriology laboratory, readings are taken at 24- and 48-hour intervals to determine gas production.

relate colonial morphology on MF plates with the biochemical characteristics and subsequent identification of these colonies.

Two hundred unusual water problems, which required special analyses to determine the causative agents, were referred to this laboratory. Taste and odour producing bacteria and fungi were the troublesome agents, though members of the iron, sulphur, sulphate-reducing, nitrogen and other rare bacterial forms were often implicated.

Samples were received from all provincial counties and organized districts in 1966, but 60 per cent of all of the bacteriological samples submitted were received from only 11 counties and one district.

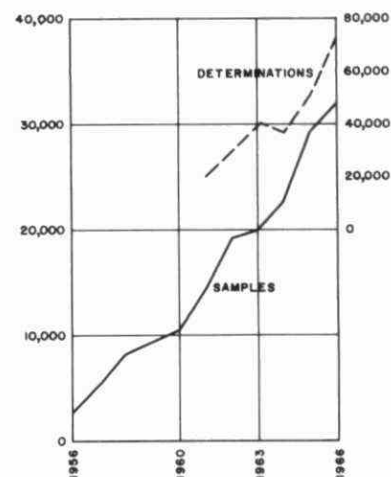
Numbers of samples increased 12 per cent over 1965, with 32,252 samples examined. The major increase was in samples obtained from the Great Lakes, though numbers of drinking water

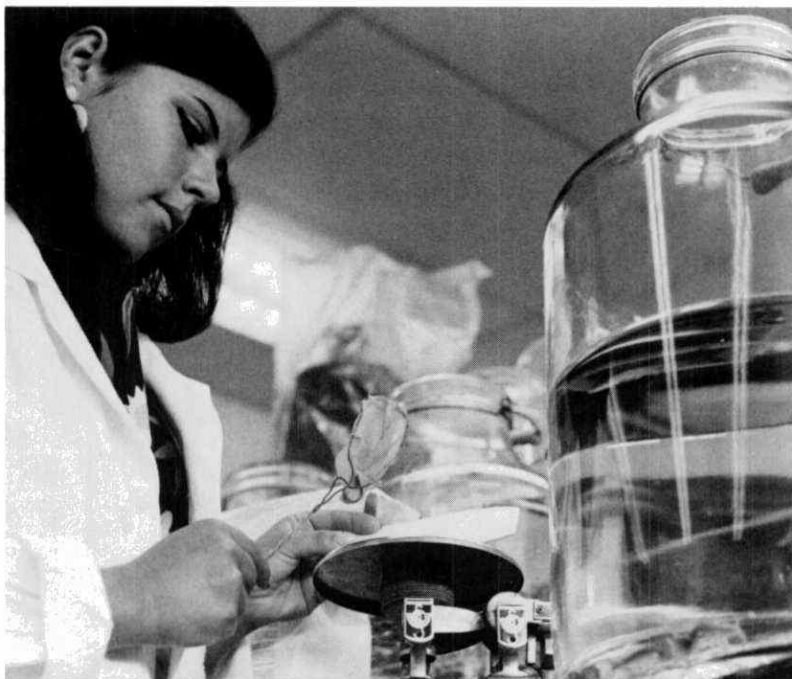
samples increased by 1,107 over submissions in 1965. Of the other government agencies submitting samples, the Department of Lands and Forests more than doubled its samples from 638 in 1965 to 1,605. Within the Commission, both the Division of Plant Operations and the Division of Sanitary Engineering increased their sample submission, while in other non-field groups samples were lower. Transportation strikes undoubtedly reduced the overall total.

Numbers of determinations increased from 43,205 in 1965 to 67,013 last year. These figures best represent the work load of the Bacteriology Branch. This increase was largely due to developmental work carried out on methods of analyses, though more tests were generally performed on each sample. Graph I indicates the increases in samples and determinations from 1956 to 1966.

**TOTAL DETERMINATION AND SAMPLES
FROM 1956 TO 1966**

GRAPH I





Surrounded by bottles of live fish, OWRC biologist seeks maximum concentration of herbicide in which they survive.

Biology Branch

The biological survey program of the Biology Branch, which is designed to evaluate the presence or absence of pollution using biological parameters, was intensified during 1966. The entire Grand River watershed was studied over a two-month period. The portion of the Grand River below Brantford was examined intensively to complement a waste-water assimilation study carried out by the Water Quality Surveys Branch of the Division of

Sanitary Engineering. Other biological studies were completed on the Nipigon River and Nipigon Bay, Lake St. John, Otter Lake, the Kaministiquia River and Thunder Bay, the St. Lawrence River, the Bruce Lake-English River system and finally, in co-operation with the Division of Industrial Wastes, Canagagigue Creek. These are situations where industrial and/or municipal wastes are affecting water quality. Catfish Creek, Otter Creek, Big Creek and Inner Long Point Bay were investigated to gather evidence of possible effects from pesticide-spraying operations in these tobacco-producing areas. Two special survey studies were undertaken. Shelter Valley Creek was examined to provide baseline information on conditions in a 'clean' stream. Portions of the Don River and a portion of the Rouge River were examined intensively in co-operation with the Division of Research. The purpose of these projects was to evaluate the effectiveness of various types and combinations of secondary and tertiary treatment at the Don West, John Street and Unionville plants.

Eight reports were completed on biological surveys which had been undertaken during 1964 and 1965. These reports provided pollution evaluations of the Holland River, German Mills Creek, Etobicoke Creek, the lower Speed River, the upper Credit River, the upper west branch of Duffin Creek, Hamilton Bay and adjacent Lake Ontario, and streams and lakes of the Sudbury area.

Studies of the effects of algae on water treatment processes were accelerated. The municipalities of Bancroft and Hanover requested assistance with taste and odour problems caused by flagellated algae. Ruhl Lake at Hanover was treated with copper sulphate for algae control and a recommendation for similar treatment was made following an investigation at Bancroft. Routine sampling programs were initiated to monitor the water supplies utilized by these municipalities in order to determine future courses of action.

Routine sampling programs for algae enumerations were carried out by the following municipalities: Sault Ste Marie, Timagami, Midland, Owen Sound, Sutton, Cobalt, Grand Bend, Elliot

Lake, Port Colborne, Hastings and Espanola. Also, a program affording a double benefit was established as part of the Great Lakes Survey Program. Weekly samples for algae enumerations were submitted from 15 waterworks plants along the lower Great Lakes system between Sarnia and Brockville. These samples will not only provide information on standing crops of phytoplankton, but will be of tremendous value in assessing the suitability of the lower Great Lakes as water supply sources. Waterworks personnel at nine municipalities completed routine algae enumerations. Since March 1966, information pertaining to a total of 369 counts has been provided by enumerators at Goderich, Union, Cedar Springs, Dunnville, Hamilton, Peterborough, Smith Falls, Cornwall and Belleville.

A storage system, organized on a watershed basis, was developed to accumulate reference collections of phytoplankton and invertebrate organisms. Card catalogues were established to provide essential information and ready reference to all samples collected by field personnel or submitted to the laboratory. These collections will have tremendous future value for research and systematic studies.

Herbicide evaluations were undertaken on farm ponds not only to determine the efficacy of several herbicides in controlling algae and vascular vegetation, but to consider various implications of their use. Application rates were evaluated in 24 ponds containing a variety of plant species. Observations were made to determine possible effects on fish and invertebrate life. Studies were continued to determine whether residues accumulate in bottom muds following successive annual treatments over a three-year period.

Seven sectional treatments were made in ponds using a contact herbicide to assess efficacy and to determine a means of avoiding oxygen depletion problems caused by decomposing vegetation.

Fifty-one applications of aquatic herbicides were completed in open-lake situations to evaluate the effectiveness of four aquatic herbicides. These tests were undertaken in Rice Lake and Che-

mong Lake in the Kawartha Lakes area, along the Rideau River System and on Rondeau Bay of Lake Erie. Information was collected at Rice Lake on the distribution of species of aquatic vegetation in this heavily utilized lake.

Bioassays were conducted at the Skeleton Lake Fish Hatchery, operated by the Department of Lands and Forests, to determine the toxicity of two herbicides to newly hatched bass. Other pesticide studies related to the testing of black fly larvicides in the field and laboratory. Three experimental insecticides were applied to black fly streams in the spring and one especially effective control agent was subsequently tested against representative stream fauna in the laboratory. Four algicides were screened for controlling algae *Cladophora* but none of these proved to be effective. Recommendations based on herbicide studies were advanced at the annual meeting of the Ontario Herbicide Committee and will be incorporated into *Guide to Chemical Weed Control, 1967* - Publication 75 of the Department of Agriculture.

A total of 110 permits were issued to authorize applications of aquatic control agents. These included 89 permits for controlling algae and vascular aquatic vegetation, ten for coarse fish control, eight for mosquito and black fly larvae and three for leeches. In excess of 800 enquiries were answered to provide assistance on aquatic control measures, and bulletins and related mimeographed information were distributed.

The involvement of the Biology Branch in the Great Lakes Survey Program included sampling of bottom fauna along in-shore areas of Eastern Lake Erie and along Lake Ontario between the Niagara River and Presqu'ile Park. A preliminary biological survey of the St. Lawrence River below Cornwall was completed. As mentioned previously, weekly samples for phytoplankton analyses were received from 15 waterworks along the lower Great Lakes. General observations were made on problems associated with development of algae *Cladophora* and more specific surveys were completed in the vicinities of Oakville and Presqu'ile.

In co-operation with the Water Quality Surveys Branch, sur-

veys were initiated to assess the effects of radioactive and chemical pollution on the Serpent and Crowe River watersheds in the Elliot Lake and Bancroft areas, respectively. On the Serpent River system, plankton and bottom fauna samples were collected from 24 lake stations and filamentous algae and bottom fauna from 21 stream stations, at monthly intervals. Collections were made from five lakes and ten stream stations on the Crowe River watershed. Radiological analyses were completed by the Radiation Protection Laboratory of the Department of Health on algae and fish, and other biota have yet to be evaluated.

In the fish toxicity and bioassay section, bioassays were completed on 92 samples, involving 121 tests and 894 determinations. These included 29 tests on pesticides, 51 on surface and ground waters, 33 on industrial wastes and eight on miscellaneous chemicals. Taste tests were completed on tainted carp from Cataraqui Bay. Forty brief reports were assembled for personnel within the Commission on the significance of toxicity evaluations.

Biological samples submitted to the laboratory showed an approximate 50 per cent increase over the preceding year. The following tables summarize the samples received and provide a breakdown of their origin.

Summary of Samples Received		Determinations Completed		Origin of Samples Received	
Algae Counts	1378	Algae Counts	1099	Biology Branch	2592
Bioassays	108	Identifications	170	Plant Operations	82
Identifications	255	Bottom Fauna and Fish	639	Sanitary Engineering	50
Bottom Fauna and Fish	1189	Bioassays	894	Research	35
Miscellaneous	330	Miscellaneous	96	Other OWRC	34
Total 1966	3260	Total 1966	2898	Other Government	15
				Public	452
Total 1965	2067	Total 1965	2447	Total	3260

Chemistry Branch I

Water and Sewage Analyses

Increased production of analyses was again the major accomplishment of the year. While the Water and Pollution sections at the main laboratory together averaged a 19 per cent increase in tests performed, an outstanding increase of 223 per cent analytical output on Great Lakes samples raised the overall Branch average 39 per cent higher than in 1965. This was accomplished without an increase in the average cost per test and in some cases with a reduction in cost, despite rises in prices of equipment and supplies. Further reductions in costs are anticipated with the introduction of the automatic colorimetric analytical equipment (Auto-Analyzer) one unit of which is presently on order.

Factors Contributing to Increased Output

Equipment obtained during the year included an automatic flame emission photometer for sodium and potassium analysis. The model selected overcame previous problems encountered with such instruments by internally compensating for random fluctuations in emission. Digital readout was also an advantageous feature of the instrument.

Branch staff constructed and successfully refined a dropping mercury polarograph for the determination of dissolved oxygen which will allow complete conversion from the time-consuming titration procedure for this test to the instrumental technique.

Evaluation tests presently being completed on a substitute BOD bottle are showing promising results. Use of the alternate bottle promises a reduction of 97 per cent in the cost of this equipment with substantial annual savings.

Special Projects

While most of the additional output of the laboratory was devoted to OWRC sampling programs, two projects undertaken for other agencies were of interest.

As part of a study comparing dental decay in children consuming fluoridated water as opposed to non-fluoridated water, the Brant County Health Unit requested analysis of over 300 well waters to ensure that these supplies were below a level of fluoride concentration which would be of significance in its comparisons. An analytical technique was devised which would yield this information without requiring completion of the entire standard analytical procedure, and the Health Unit was pleased with the results obtained.

Another analytical survey of interest was a comparative mineral analysis of snow and rain waters collected by Queen's University. This yielded informative data on the redistribution of minerals brought about by precipitation. Although these minerals are present only in trace concentrations, they amount to significant totals (tons per acre) when our average rainfall of 35 inches per year is considered. The study is planned to be continued in more detail.

As part of the OWRC exhibit, a major part of the chemical analytical work on water samples was transferred temporarily to the laboratory booth at the Canadian National Exhibition. The laboratory equipment display, and the opportunity to witness analytical tests being performed, attracted a good deal of interest on the part of visitors.

A number of new analytical procedures were added to the work of the Branch, including tests for phosphates, anionic detergents, volatile acids, sodium, potassium, sulphides, chlorine demand, threshold odour, determination of the rate constant 'k' for BOD reactions, and the separate determination of carbonaceous as opposed to nitrogenous oxygen demand. In order to comply with frequent requests, summarized descriptions of those analytical methods in most constant use were prepared in a form suitable for public distribution. Descriptions of the methods used for the determination of solids and phosphorus were completed and further summaries were planned.

In order to prepare an inventory of the contribution of pollu-

tants and nutrients from sewage treatment plants discharging to the Lower Great Lakes, a tabulation was prepared of all samples collected and tests performed in 1966 with respect to these plants. This tabulation was being evaluated to define the amount of additional analytical work necessary to provide a more complete inventory of input.

The accompanying tables and graphs indicate the source of samples received for chemical analyses, their seasonal distribution and the contribution of each section to the total workload.

Great Lakes Laboratories

In the past year a rapid growth was experienced in the analytical services provided by Commission staff engaged in the Great Lakes Project. The previous year a field laboratory had been established for a period of four months in the Kingsville Water Treatment Plant, but the nature and scope of the 1966 program made it imperative to obtain new and bigger quarters for the laboratory, in the northeast London region. A second field laboratory was required to handle the sampling program for Lake Ontario, and it was decided to incorporate this function within the main laboratory building.

An intensive recruitment program was undertaken to obtain trained qualified staff to assist in running these field operations. The services of a scientist with experience in the water pollution field were obtained for the London laboratory, and some of the senior technicians in the main laboratory were assigned to London to provide trained staff. Senior technicians were also assigned to the Toronto field laboratory, and additional supervision was provided by the senior staff at the main laboratory.

A new feature of the Great Lakes Project was the introduction of computer techniques for the storage and retrieval of data which is produced by the field laboratories and reported in a form suitable for data processing.

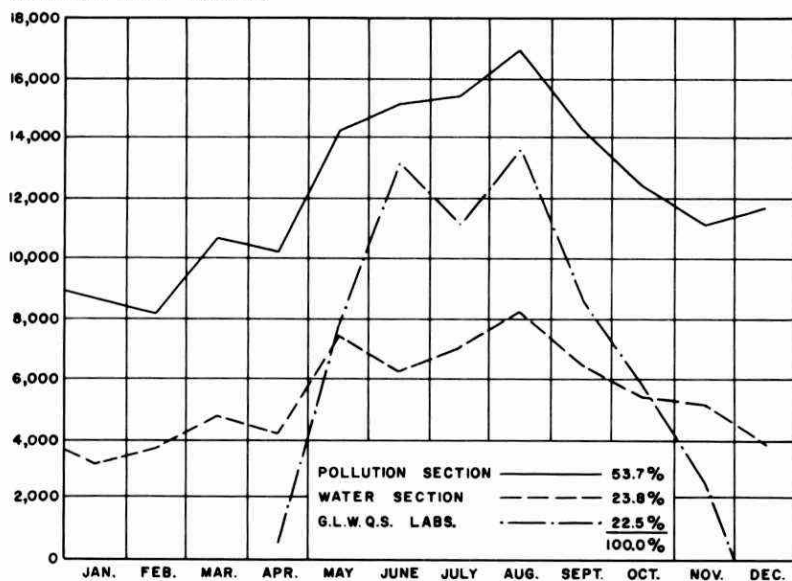
The number of samples received at the Great Lakes field laboratories amounted to 6,887 and these were almost evenly distributed between the two laboratories. Tests performed amounted to

62,249, equivalent to a 223 per cent increase over the 1965 program. Apart from the sheer volume of samples handled, the laboratory staff were also required to adopt new and more detailed reporting procedures and, at the same time, to maintain a high degree of precision and accuracy in measuring the requested parameters.

Special Projects

The August meeting of the IJC Sub-Committee on Great Lakes field programs directed the owrc to prepare standard samples for distribution among the Canadian agencies engaged in Great Lakes work. The purpose of this co-operative study was to assess the merits of the analytical procedures being used by the participating agencies and to assure that the laboratories were obtaining comparable results. Samples were prepared and distributed by the laboratory staff, and the analytical data obtained were

CHEMISTRY BRANCH I
Water and sewage analysis
SECTION TEST TOTALS

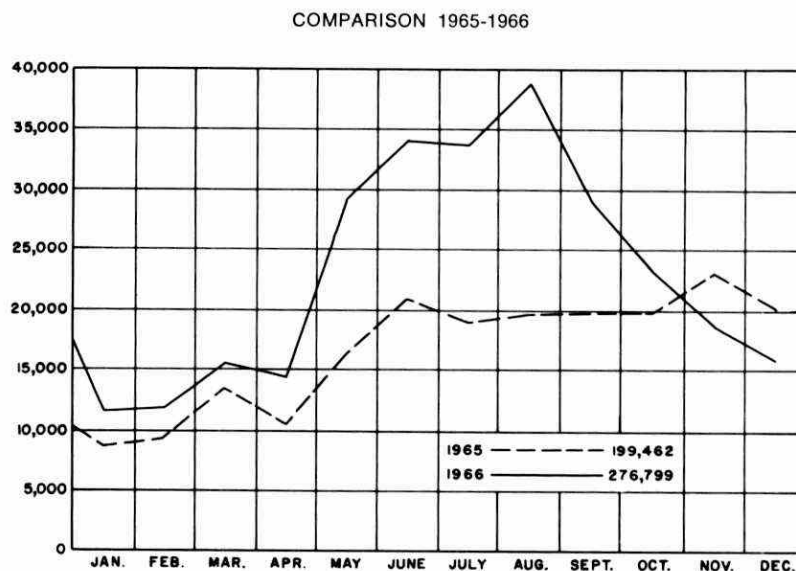


tabulated and circulated to the participating agencies.

During the course of the year, a Committee on Methodology with reference to the Great Lakes was established. Meetings were held in Kingston and Toronto, and one of the results of these meetings was the compilation, in booklet form, of all the analytical methods used by the agencies engaged in Great Lakes work. Standardization of nomenclature, sampling procedures and methods of reporting data were some of the other items which engaged the attention of the participants.

Towards the end of the year, preliminary plans were drafted for expanding the London field laboratory. When the changes are completed, facilities will be available at the London laboratory for the performance, on a limited scale, of routine water and sewage analysis. A training program was instituted at the main laboratory to train the London laboratory staff to carry out these additional analyses.

CHEMISTRY BRANCH I
Water and sewage analysis
MONTHLY TEST TOTALS



Chemistry Branch II

Industrial Wastes Analyses

Good progress was achieved during the first full year of existence of the Branch. Inorganic and organic chemistry sections were formed to expedite the heavy analytical work load. A group of highly skilled technical personnel was assembled including an excellent core of scientists. The acquisition of some additional instrumentation permitted the start of interesting, much-needed programs in several important areas of aquatic environmental pollution.

Routine Analytical Program

Requests for routine analyses continued to increase from many sources. In excess of 13,000 tests were completed in 1966, an increase of about 17 per cent over 1965. Analytical services to industries increased, although more companies were introducing facilities into their laboratories for water and effluent analyses. The expansion of the organic laboratory resulted in a greater number of samples for analysis, especially in relation to contamination of potable water supplies by petroleum hydrocarbons from various sources. Special laboratory tests were conducted on many problems relating to waste treatment. Studies continued on the Great Lakes and interconnecting channels, mainly with respect to organic pollution.

Special Studies

Extensive method evaluation and development continued, dealing with almost two dozen parameters for effluent and water quality characterization. Most progress was made on the analysis of metals and organics in water. Intensive studies were conducted, with good success, on atomic absorption spectrophotometry as a tool for metal analysis.

A program of analyses for residues of certain pesticides in water

and fish was started this year. Paper, thin layer, and gas chromatographic techniques were introduced, backed up by ultraviolet and infrared spectroscopy. Most work was done on chlorinated hydrocarbon compounds.

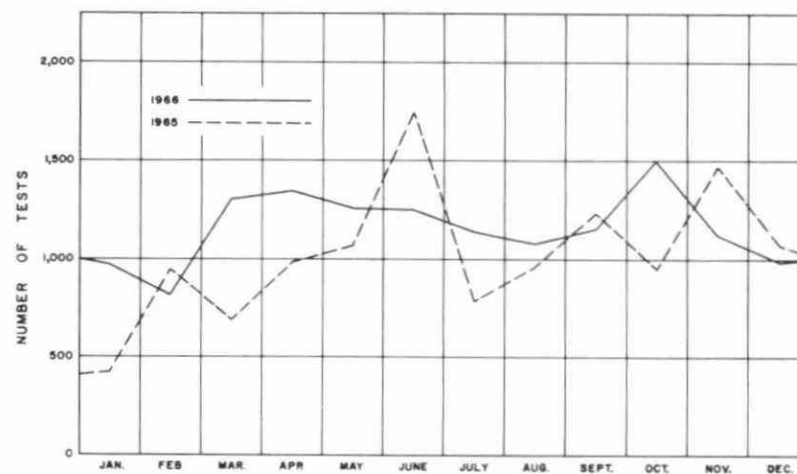
Carbon adsorption studies were initiated on the Great Lakes and internal provincial waters. The design of sampling equipment was improved and standardization of operating conditions achieved. Analytical procedures continued to be assessed.

General

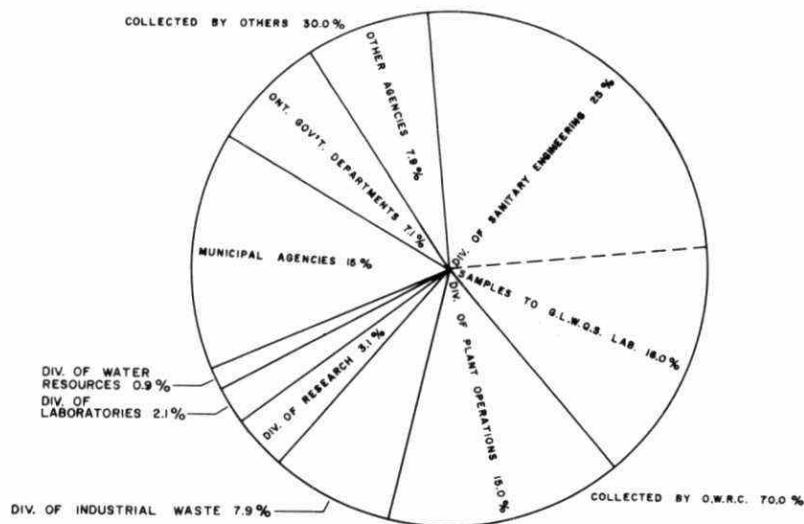
Modern equipment, particularly applicable to the analysis of compounds in water, was assessed continuously. Participation within the Analytical Reference Service sponsored by the United States Public Health Service was started with two studies this year. Testimony on analytical results was given at a number of court hearings relating to pollution of natural watercourses. Studies continued on several other projects such as future laboratory requirements and electronic data processing.

CHEMISTRY II: ANNUAL REPORT

Comparison of Monthly Totals for Tests in 1965 and 1966



SUMMARY OF CHEMISTRY SAMPLE SOURCES



Some 200 unusual water problems, involving taste- and odour-producing bacteria and fungi, were investigated.

BY SOURCE

	1965 Samples		1966 Samples	
	Number	%	Number	%
Collected by OWRC Staff				
Sanitary Engineering				
— Main Laboratory	10758	30.1	10767	25.0
— G.L.W.Q. Survey Lab.	2894	8.1	6887	16.0
Plant Operations	4640	13.0	6462	15.0
Industrial Wastes	2486	6.9	3413	7.9
Research	2632	7.6	1368	3.1
Laboratories	943	2.5	944	2.1
Water Resources	429	1.2	373	0.9
OWRC Total	24782	69.4	30214	70.0
Collected by Others				
Municipal Agencies	5809	16.3	6420	15.0
Ontario Government Agencies	2598	7.3	3136	7.1
Others	2500	7.0	3370	7.9
Total	10907	30.6	12926	30.0
Annual Total	35689	100.0	43140	100.0

BY TYPE

	1965	1966	% Change
Sewage	14740	15064	+ 2%
Water	7927	9272	+17%
River, including G.L.W.Q.S.	10536	15430	+46%
Industrial Wastes	2486	3374	+36%

CHEMISTRY BRANCH II: TESTS PERFORMED IN 1965 AND 1966

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1966	918	764	1,284	1,308	1,211	1,203	1,103	1,099	1,167	1,465	1,134	932	13,588
1965	368	818	606	906	1,055	1,718	727	878	1,199	844	1,410	1,052	11,581
% Change	+150	-7	+111	+44	+15	-30	+52	+25	-3	+74	-20	-11	+17

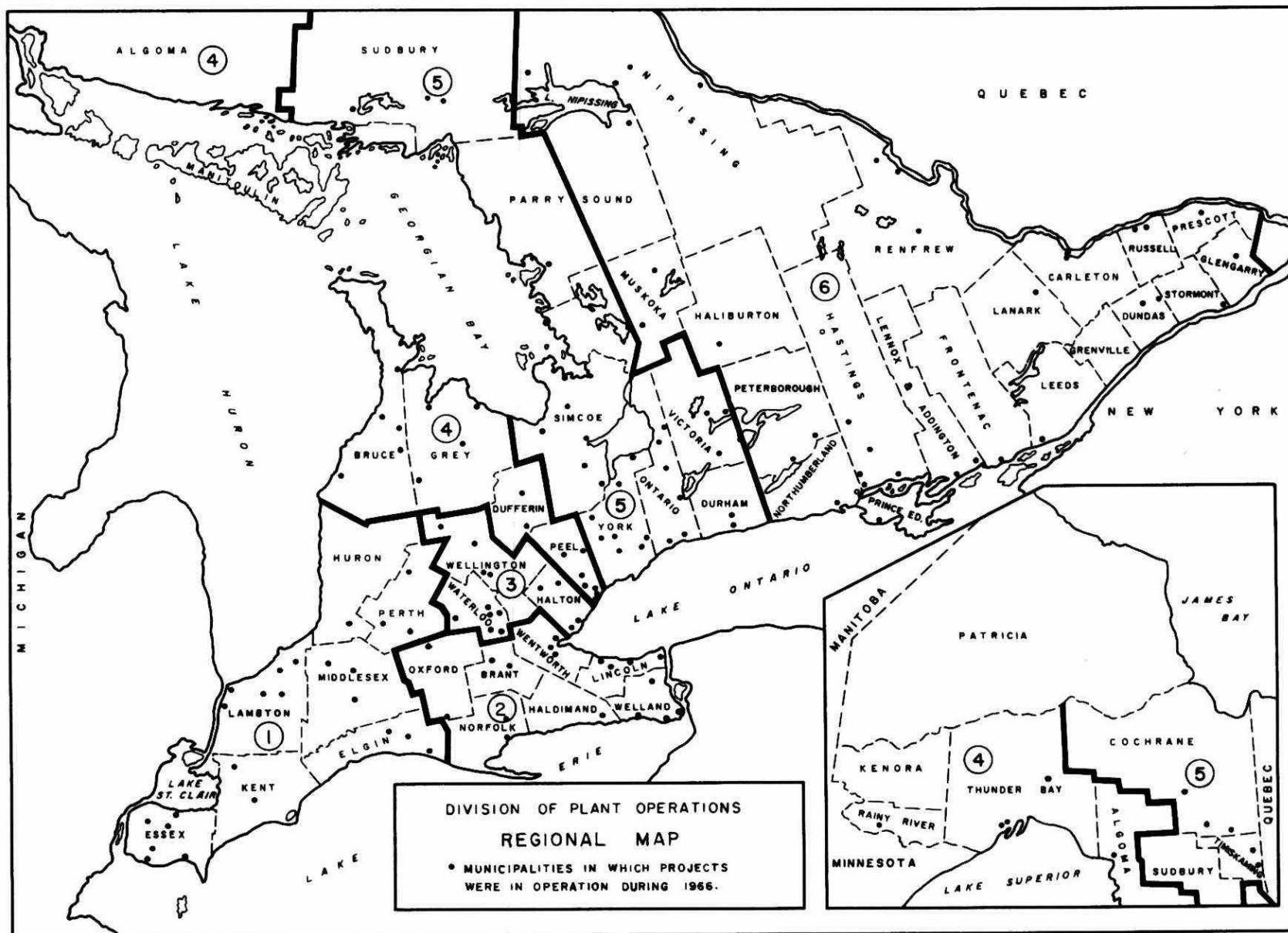


FIGURE I
36

Division of Plant Operations

B. C. PALMER, *Director* C. W. PERRY, *Assistant Director*

Water and Pollution Control Projects which are financed and built by the OWRC are operated by the Commission's Division of Plant Operations. By the end of the year there were 271 projects operating in 176 municipalities.

Role of the Division in New Project Development

During the various stages of design for new projects, the Division works in close liaison with other Divisions in reviewing the proposals submitted by consulting engineers. Operating cost estimates are provided to facilitate the development of the detailed cost analyses required for final approval by the Ontario Municipal Board and municipal councils. All new work proposed is reviewed in the light of past operating experience.

Before a project is completed, operating procedures are reviewed in detail with municipal officials in order to establish liaison between the municipal and provincial staffs concerning the project.

Operation of Projects

When projects go into operation, they are manned, in most cases, by full-time or part-time Commission staff. Where the project is very small and is an integral part of an existing municipal system, or where the only people in the area who are qualified to look after the works are municipal employees, the municipality can provide daily operational assistance under the general supervision of the Division's Regional Operations Engineer.

Staff Activities

For the purposes of administration, the Province is divided into six regions, the boundaries of which are shown in Figure I. An Operations Engineer is responsible for all the projects in his region. He prepares Operating Budgets, establishes quality and

cost control procedures, ensures that an adequate number of properly trained operators are on the job and utilizes the services of specialist groups within the Division, from other Divisions, or from outside the Commission to assist him in solving operating problems.

The Operations Engineer reports to a supervisor who, by participating in the development of the policies established at Division level, ensures a high standard of operation.

Project Services

The Project Service section investigates field operating problems, evaluates operating results, appraises new chemicals or processes, reviews plans and specifications for new projects, prepares a yearly summary report on process operation, prepares special reports, and supervises the Division's statistical activities.

During the year, check lists were completed to assist Division personnel in reviewing plans and specifications for sewage pumping stations and waste stabilization ponds. A report was prepared summarizing the design details, operating problems, treatment results and operating costs of all OWRC-operated waste stabilization ponds to date.

Studies on the use of polyelectrolytes to replace lime and ferric chloride as coagulant aids in vacuum filtration of sludge were carried out at several water pollution control plants, including Brantford, Waterloo, Galt and Kitchener. At the Lakeview water pollution control plant, evaluation of polyelectrolytes to enhance clarification was initiated on a laboratory and full-plant-scale basis.

Also at the Lakeview plant, a light absorption-type turbidimeter was installed in order to appraise its effectiveness in continuously measuring and recording suspended solids in the final and primary effluent.

In addition, assistance was given to operating personnel in assessing difficult operating problems and reviewing plans and specifications of unfamiliar types of treatment processes.

Statistics Section

The Statistics Section is responsible for acquiring, checking and compiling the daily operational and analytical data received from all sewage and water projects operated by the Division. Using this daily plant data and the sample results received from the Division of Laboratories, the section maintains an up-to-date card system which summarizes the operational parameters and treatment results for each project.

Monthly operating costs are compiled and various unit costs are determined and compared with the budgeted amounts. Operating costs, in the case of integrated projects, are apportioned on a flow basis to the various participants.

Maintenance

To protect the Commission's capital investment and to ensure the continuity of treatment processes at all projects, a high standard of preventive maintenance is required. The main functions are inspection, supervision, training, troubleshooting and establishing sound maintenance procedures at all projects.

Regional Co-ordinators responsible for this program are supplemented by a highly trained staff of specialists skilled in the fields of electronics, instrumentation, industrial controls, flow measurement, hydraulics and electrical equipment repairs.

During the past year, the Maintenance groups have established a priority program which is designed to further minimize the possibility of interruptions to treatment from major equipment breakdowns. The system of reporting inspections, repairs and problems encountered on all equipment at all projects has been revised and improved.

Equipment Evaluation

On the basis of past performance, operating records and maintenance reports and data, all equipment is evaluated on its performance. Electronic data processing of historical operating and maintenance data is being developed to improve the techniques of selection of materials and equipment for future projects.

SAFETY

Ensuring an adequate safety program at all projects was of continuing significance.

The OWRC Operators' Safety Manual is under constant editing, enlargement and revision as new legislation comes into being. This manual is receiving recognition from other provincial government departments, industry and municipalities.

Close liaison is maintained with personnel of the Department of Labour and the Department of Energy & Resources Management in the safety aspects of the repair of gas-producing elements of Commission plants and the utilization of digester gas produced in the purification process.

In addition to the safety inspections carried out at the projects, on-site training of plant operators was continued. Formal safety lectures and demonstrations were given at the OWRC Water & Sewage Works Operators' Training courses.

There were no fatalities or permanent injuries to any of the Commission's plant staff during the year.

A table showing frequency and severity rates of accidents during 1966 with the latest comparative figures for Canada and North America, as compiled by the AWWA for 1965, is given below. This indicates that the Commission's Safety program is well worthwhile and has resulted in an improved accident record.

Year	Disabling Injuries	Frequency Rate	Severity Rate
1963 (OWRC)	6	17.0	180
1964 (OWRC)	37	25.0	440
1965 (OWRC)	30	33.0	351
1966 (OWRC)	36	26.0	256
AWWA CANADA 1965	479	45.6	674
AWWA NORTH AMERICA 1965	3976	23.2	684

Frequency Rate Disabling injuries per million man hours worked.

Severity Rate Man-days charged to disabling injuries per million man hours worked.

Region I

Forty-eight projects were in operation during 1966. Nineteen were treatment facilities and the remainder consisted of distribution or collection facilities.

Reports on expansion of the Union Water System and the Tillsonburg Water Pollution Control Plant were prepared by consulting engineers.

Region II

Thirty-one projects were in operation during 1966. Thirteen were treatment facilities and the remainder consisted of distribution or collection facilities.

A report on expansion and improvements to the Dunnville Area Water System was requested from a firm of consulting engineers.

Region III

Twelve complete-treatment activated sludge type plants were in operation for the entire year with no additional plants being added during the year. Consulting engineers were engaged to prepare plans for the enlargement and renovation of two of the plants. In addition, it was noted that the loading on another two plants was increasing and studies on these plants were implemented.

Plans for the enlargement of one waste stabilization pond system were completed and construction initiated during the year. Discussions in conjunction with the Division of Industrial Wastes were held with two industries whose wastes were contributing to the increased loading on a waste stabilization pond system in one municipality and on a treatment plant in another municipality.

Region IV

Fifty-one projects were in operation during 1966. Twenty-two were treatment facilities, the remainder consisted of distribution or collection facilities.

Enlargements to the Lakeview Water Pollution Control Plant and the Brampton-Chingacousy Water Pollution Control Plant,

both on the fringes of Metropolitan Toronto, were under construction during the year. The enlargements are scheduled to go into operation in 1967.

The Township of Toronto terminated three sewer projects during 1966.

Region V

Plans for the enlargement of one of the four complete-treatment plants in the region were concluded during the year. Also, planning was started for the addition of secondary treatment facilities to one of the four primary plants. By the end of the year, nine waste stabilization ponds were in operation, two of which were added during the year.

Preliminary arrangements were made for the engaging of consulting engineers to plan renovation and enlargement to the complete-treatment water plant in one municipality and for the provision of an additional well at another.

Region VI

Eleven waste stabilization pond systems were in operation by the end of the year. This included one installation which was brought into operation during the year. Sampling at two of the installations indicated that the loading gave cause for concern, and as a result, plans for the enlargement of one installation were made, and steps were taken to decrease the organic load on the other. Adequate sampling programs were maintained at all projects to ensure the availability of reliable data for planning.

Preliminary plans were completed for the enlargement of one of the six secondary treatment plants in the area and for the enlargement and addition of secondary treatment to one primary plant. As with projects in other regions, comprehensive sampling was utilized to maintain adequate data regarding the loading on the projects.

COUNTIES AND DISTRICTS

Region I: Elgin, Essex, Huron, Kent, Lambton, Middlesex, Perth.

- Region II:** Brant, Haldimand, Lincoln, Norfolk, Oxford, Welland, Wentworth.
- Region III:** Halton, Waterloo, Wellington.
- Region IV:** Algoma, Bruce, Dufferin, Grey, Kenora, Manitoulin, Peel, Rainy River, Thunder Bay.
- Region V:** Cochrane, Durham, Muskoka (west half), Parry Sound (west half), Simcoe, Sudbury, Timiskaming, Victoria, York.
- Region VI:** Carleton, Dundas, Frontenac, Glengarry, Grenville, Haliburton, Hastings, Lanark, Leeds, Lennox and Addington, Muskoka (east half), Nippissing, Northumberland, Parry Sound (east half), Peterborough, Prescott, Prince Edward, Renfrew, Russell, Stormont.

STATISTICAL SUMMARY

Statistics, indicative of the Division's program, follow:

- (A) Total Capital cost of works in operation as of December 31, 1966:

SEWAGE PROJECTS	\$ 87,126,597
WATER PROJECTS	28,861,427
TOTAL	\$115,988,024

Capital value of works which came into operation in 1966:

SEWAGE PROJECTS	\$ 1,516,659
WATER PROJECTS	2,029,985
TOTAL	\$ 3,546,644

(B) PROJECTS IN OPERATION:

Year	Water	Sewage	Total	Increase
1958	9	6	15	—
1959	21	13	34	19
1960	32	33	65	31
1961	53	58	111	46
1962	74	81	155	44
1963	85	106	191	36
1964	96	134	230	39
1965	105	150	255	25*
1966	112	159	271	16**

* There were 26 new projects started, less one termination — 60-S-58 (Chelmsford).

** There were 19 new projects started, less three terminations — 57-S-1, 61-S-78 and 63-S-138 (all in Toronto Twp.).

(C) TOTAL OPERATING COSTS OF PROJECTS:

WATER	\$ 501,065
SEWAGE	2,505,166
TOTAL	\$ 3,006,231

(D) TOTAL OPERATORS ON OWRC PAYROLL:

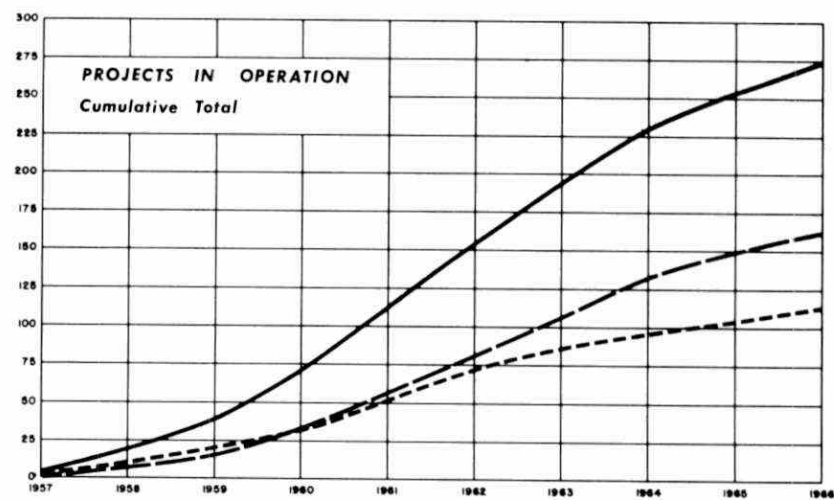
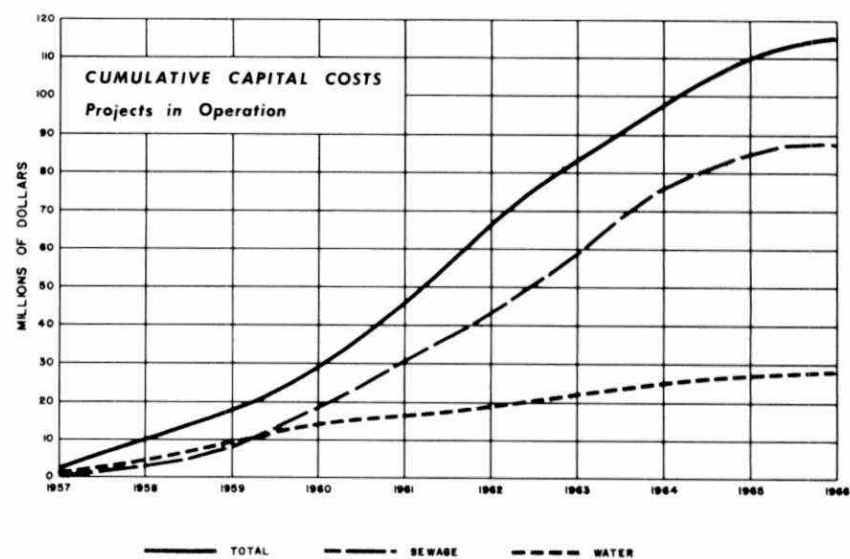
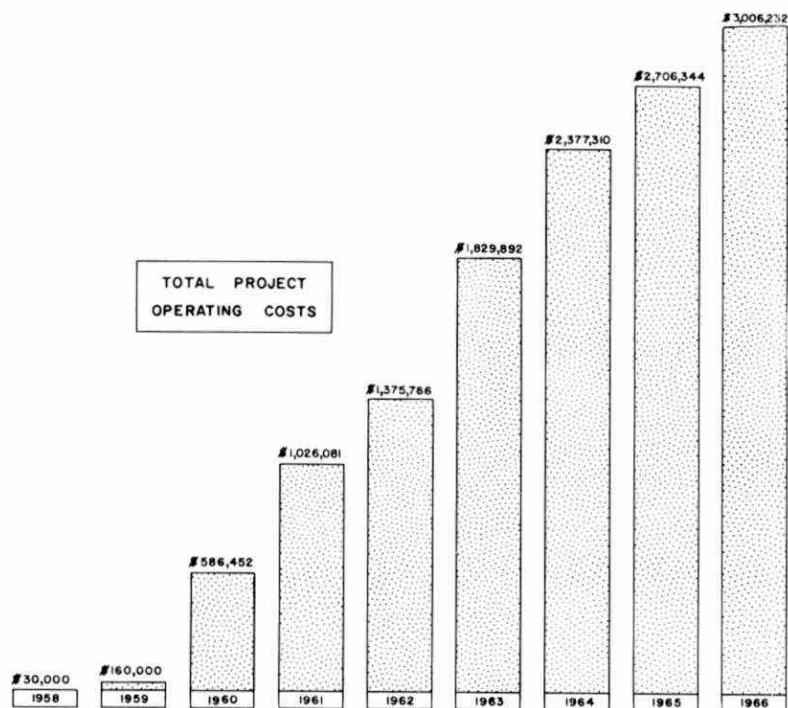
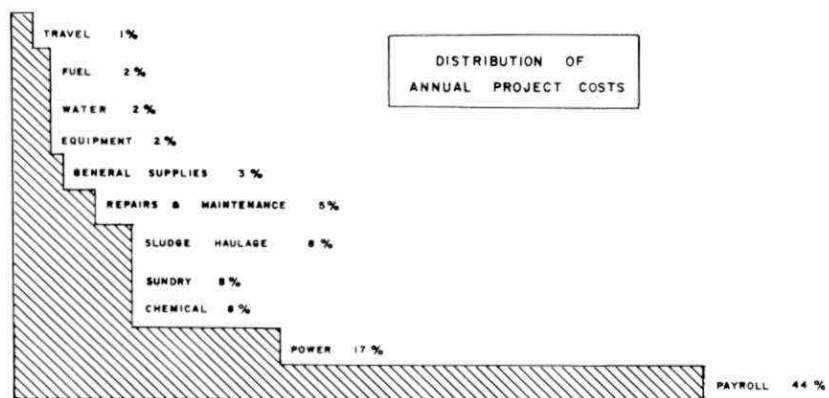
1958	15	1961	145	1964	210
1959	22	1962	162	1965	231
1960	92	1963	191	1966	239

(Water systems operators — 40: Sewage plant operators — 199)
17 of these were part-time operators.

- (E) TOTAL VOLUME OF SEWAGE TREATED IN 1966: 42 billion gallons. The 271 projects in operation served a total of 176 municipalities and seven industries.

Fire demonstration was feature of safety conference at Lakeview.





Division of Project Development

P. G. COCKBURN, *Director*

With more attention being centred on the provision of water treatment facilities and sewage treatment facilities by the Province on a usage basis, the Division experienced an impressive increase in the number of Provincial programs being developed to provide these services throughout the Province. The majority of municipalities participating in these Provincial programs are those which normally could not afford the added debenture debt if such projects were financed on their own by the sale of debentures, or under a standard municipal/OWRC agreement.

In addition to the Provincial programs, there has been increased activity in Regional Studies, as there appears to be a continual need to consider the provision of water and sewage treatment facilities on an area basis. Considerable time was spent on developing proposals for the Southern Peel County area sewage and water programs and the Lake Erie Water Supply System.

The Division became more involved in the preparation of agreements in conjunction with the Legal Branch. A legal officer was retained on staff to concentrate on this activity. Draft agreements for water and sewage programs for the Southern Peel County area have been prepared but not finalized. This has proven to be a major task in view of the involvement of five growing municipalities and the intention of the Province to provide the necessary water and sewage service for the area.

Although there has not been an increase during the year in the number of Commission projects involving the construction of sewer and water distribution systems, it is anticipated that this situation will alter in the coming year as more municipalities participate in the Provincial programs and the associated need for these systems increases.

The work carried out by the Division is described in greater detail in the following Branch reports.

Projects Branch

(a) Municipal Projects

During the year 26 new municipal projects were accepted by the Commission. There were 15 sewage projects at a total estimated value of \$3,032,523 and 11 water projects at a total estimated value of \$1,514,919. A tabulated summary of the activities of the Branch pertaining to municipal projects follows.

STATISTICS — MUNICIPAL PROJECTS — 1966

	New Projects Requested	New Projects Accepted	Preliminary Agreements Executed	Final Agreements Executed	Rating Proposal Prepared	Final Statement Prepared	OMB Notices Prepared	Hearings
January	2	—	—	2	5	2	6	—
February	2	1	1	5	—	2	1	1
March	1	4	3	3	6	3	2	2
April	3	2	2	4	3	2	3	1
May	6	3	4	—	1	1	2	—
June	—	4	4	2	3	2	2	1
July	3	1	—	—	—	2	2	1
August	2	2	2	4	2	3	1	1
September	2	4	2	2	2	3	—	—
October	2	1	1	3	2	4	1	2
November	4	3	7	3	6	1	1	—
December	2	1	2	2	2	2	3	—
Totals 1966	29	26	28	30	32	27	24	9
Totals 1965	35	33	31	35	34	27	26	15

(b) Provincial Programs

The Branch is at present dealing with some 97 municipalities in connection with Provincial programs and is currently developing projects in 84 of these. The remainder are being held in abeyance pending further information being received from the municipalities or from regional studies. The estimated value of the programs being developed is \$52,943,725 for sewage works and \$7,574,400 for water works. These programs provide major facilities such as treatment plants, pumping stations and connecting facilities between the municipal collector sewer or the municipal water distribution system. The Commission enters into an agreement with the municipalities for the provision of such services at a rate based on usage by the municipality. A list of the programs currently under development follows.

PROVINCIAL PROGRAMS

*Cost based on preliminary estimates

Municipality	Description	Capital Cost
Village of Ailsa Craig	Water works program	\$ 150,000*
Town of Alliston	Sewage works program	400,000*
Village of Arthur	Acquisition of existing sewage works	109,825*
Village of Beaverton	Sewage works program	832,000
Village of Beeton	Sewage works program	101,521
City of Belleville	Sewage works program	2,041,667
Township of Blenheim	Water works program	250,000*
	Sewage works program	150,000*
Village of Bobcaygeon	Water works program	233,500
Township of Bucke Area	Sewage works program	100,000*
Town of Bradford	Sewage works program	330,000
Town of Bruce Mines	Sewage works program	200,000*
	Water works program	200,000*
Village of Burk's Falls	Sewage works program	200,000*
	Water works program	200,000*
Town of Campbellford	Sewage works program	898,000
Village of Cannington	Sewage works program	147,492
Town of Carleton Place	Sewage works program	841,700
Village of Cayuga	Sewage works program	142,000
Village of Chesterville	Sewage works program	109,600
Town of Cobourg	Sewage works program	1,150,000
Twp. of Colchester South-Harrow Area	Water works program	1,800,000
Village of Coldwater	Sewage works program	257,950
City of Cornwall	Sewage works program	7,559,000
Town of Deseronto	Sewage works program	665,630
Village of Drayton	Sewage works program	124,500*
	Water works program	250,000*
Town of Dresden	Sewage works program	450,000*
Village of Dutton	Sewage works program	100,000*
Township of Dysart et al	Water works program	100,000*
	Sewage works program	100,000*
Township of Emo	Water works program	209,000
	Sewage works program	93,300
Village of Eganville	Sewage works program	154,000
Township of Eramosa	Water works program	200,000*
	Sewage works program	150,000*

Town of Essex	Sewage works program	225,000*
Town of Geraldton	Sewage works program	221,800
Village of Glencoe	Sewage works program	344,000*
Village of Grand Bend	Water works program	175,000*
Village of Grand Valley	Sewage works program	150,000*
Town of Haileybury	Sewage works program	757,050*
Town of Harrow	Sewage works program	1,041,080
Township of Hanmer	Sewage works program	672,000
Town of Hespeler	Sewage works program	600,000*
Town of Hearst	Sewage works program	150,000*
Township of Humberstone	Sewage works program	200,000*
Town of Huntsville	Acquisition of existing sewage works	270,000
	Sewage works program	97,275
Township of Ignace	Water works program	50,000*
Town of Latchford	Sewage works program	343,500
Village of L'Orignal	Water works program	150,400*
Township of London	Sewage works program	406,396
Township of Longlac	Sewage works program	215,000
Village of Madoc	Acquisition of existing water works	50,000
Village of Marmora	Sewage works program	120,000*
	Acquisition of existing sewage works	195,249
Town of Meaford	Sewage works program	300,000*
Village of Merrickville	Sewage works program	144,600
Town of Midland	Water works program	1,000,000*
Village of Newcastle	Sewage treatment works	181,000*
Twp. of North Himsforth	Sewage works program	150,000*
	Water works program	150,000*
Town of Parry Sound	Sewage works program	788,217
Township of Pakenham	Sewage works program	108,000
Town of Parkhill	Water works program	400,000
Village of Pickering	Sewage works program	453,000
Village of Port Burwell	Water works program	768,000
Village of Port Carling	Sewage works program	150,000*
Village of Port Perry	Sewage works program	496,340
Village of Port Stanley	Sewage works program	591,000
Town of Powassan	Acquisition of existing sewage works	99,800
	Sewage works program	1,417,000
Town of Prescott	Sewage works program	443,000
Township of Red Lake	Water works program	742,000
	Sewage works program	126,600
Village of Richmond	Sewage works program	300,000*
Town of Ridgetown		

Township of Schreiber	Sewage works program	100,000*
Town of Seaforth	Sewage works program	150,000*
Twp. of Shackleton & Machin	Water works program	100,000*
	Sewage works program	100,000*
Town of Southampton	Sewage works program	354,000
Town of Stayner	Sewage works program	473,000
Town of Sturgeon Falls	Sewage works program	1,379,200
City of St. Catharines	Sewage works program	17,300,537
Town of St. Marys	Sewage works program	630,000
Town of Thessalon	Sewage works program	330,000
Town of Thornbury	Sewage works program	150,000*
Village of Victoria Harbour	Water works program	117,000
Town of Wallaceburg	Sewage works program	1,600,000*
Village of Waterdown	Acquisition of existing sewage works	210,914
Township of Wilmot	Sewage works program	162,500
Village of Woodbridge	Sewage works program	372,132
Township of Woolwich	Water works program	279,500*
	Sewage works program	216,350*
Village of Zurich	Sewage works program	250,000*

The following is a statistical summary of Provincial programs. Action on some of the programs has been held in abeyance where there was conflict with other arrangements such as Regional Studies or where additional information is required before further development can proceed.

SUMMARY

Number of applications for sewage works	83
Number of applications for water works	26
Total number of Provincial projects	109
Total number of municipalities participating in the Provincial program	97
Total number of regional studies (13 water, 3 sewage)	16
Total number of engineering agreements executed in retaining consulting engineers	54
Total number of reports received from consulting engineers	34
Total number of tentative rates approved by the Commission	10
Total number of agreements for final design executed	2

(c) Regional Studies

There are at present 13 studies being developed for regional water supply systems and three studies for regional sewage treatment facilities. A brief summary on the status of each study is

presented below and, when available, estimates of capital costs have been included.

Amherstburg-Anderdon-Malden Area Water Supply System

Following information meetings with area representatives, five municipalities resolved to participate in an area water supply system. Consulting engineers have been authorized to proceed with a design report on the water supply requirements of the area. The capital cost is estimated at approximately \$2,035,000.

Belleville-Trenton Area Water Supply System

Consulting engineers have been authorized to prepare a preliminary report on the water supply requirements of this area. A draft of the preliminary report has been received by the Commission, and further development and investigation is planned for 1967. The approximate capital expenditure of this area water supply system is estimated to be \$14,284,000.

Bleazard Valley Regional Water Supply System

After several municipal councils requested the Commission to develop a regional water supply system, consulting engineers were authorized to prepare a preliminary report on the water requirements of the area. In order to complete the study, an extensive test-drilling program was authorized, and this part of the study should be completed early next year.

Napanee/Deseronto Regional Water Supply System

After receiving a report on the water supply requirements of the area, the Commission presented a tentative proposal to the participating municipalities during November 1966. Further development of this project is subject to the approval of the proposal by the municipalities. The estimated capital cost of this system is \$1,139,560.

Eastern Welland County Regional Water Supply System

A report on the water supply requirements of this area was received by the Commission. The proposals presented in the report are currently under review and it is planned to hold an information meeting in the area in 1967.

County of Kent Regional Water Supply System

An engineering report on the water supply requirements of the area was received during 1966. During November a firm proposal, including tentative rates, was presented to a meeting of area representatives. Further development of this system is subject to the acceptance by the municipalities. The estimated capital expenditure involved in this project is \$7,383,115.

County of Lambton Regional Water Supply System

A proposal with water rates was presented to the area municipalities in 1966. Further development of the system is dependent on the indications received from the municipalities. The estimated capital cost of this project is \$13,423,000.

County of Lincoln Regional Sewage Disposal System

A preliminary engineering report on the sewage works requirements of this area was received during 1966. After receiving approval from the participating municipalities on information presented at an area meeting, a tentative rating proposal is under preparation and will be presented to the municipalities early in 1967. The estimated capital cost is \$10,691,000.

Lower Grand Valley Regional Water Study

After receiving the engineering report on the water supply requirements of the area, a proposal was presented to the municipalities during November 1966. Further development of this project is subject to receiving the approval of the proposal by the municipalities. The estimated capital cost of this project is \$20,600,000.

Middle Grand Valley Regional Water Study

Terms of reference were being finalized for the preparation of a preliminary report on a water supply for the Kitchener-Waterloo area.

Lake Temiskaming Regional Water Study

A consulting engineering firm is preparing a design report on the water supply requirements of this area. This report is expected

to be completed early in 1967. The capital cost is currently estimated at \$897,689.

County of Peel Regional Water & Sewage Programs

At several meetings of area representatives during the past year, tentative rates for both sewage and water services were discussed. The rate for sewage was accepted and the water proposal was still under review at the end of the year. The capital expenditure for both systems is expected to reach \$81,725,600 (\$40,481,600 for sewage works and \$41,244,000 for the water supply system).

County of York, Central Area Water & Sewage Study

During the past year the Commission authorized a consulting engineering firm to prepare a preliminary report on the water and sewage works requirements of this area. Discussions with the Corporation of Metropolitan Toronto are scheduled for early in 1967.

Tilbury Area Water Study

As a result of interest shown in a water supply system for the Tilbury Area, the Commission is considering authorizing a consulting engineering firm to prepare a report on the water supply requirements of the area.

County of Essex Regional Study

During the past year, the report on the water supply requirements in this region was used as the basis for the development of the Amherstburg-Anderdon-Malden regional water program and the Colchester South-Harrow Area Provincially-financed water works program.

Property Branch

The year 1966 saw this Branch's land acquisition program for regular Commission projects maintained at the 1965 level. The trend toward projects for smaller municipalities continued throughout 1966 having the effect, in general, of reducing the amounts paid for individual sites and easements.

There was a marked increase in the volume of work connected with Provincial programs, however. The main portion of the Lake Huron Water Supply System property program was handled in 1966, with settlement being achieved on most outstanding problems and most damage claims being settled by the end of the year. One arbitration was held before the Ontario Municipal Board on the terminal reservoir site for the Lake Huron Water Supply System.

Work commenced on the Lake Erie Water Supply System in October and progressed smoothly. At the end of December only five parcels remained outstanding.

Taxes

The Commission policy on taxation review for regular projects was unchanged during 1966. Where an assessment was approved by a municipality which was responsible for paying taxes, no further action was taken. Where requested, however, the assessment was reviewed and a report submitted to the municipality. The assessment was appealed where circumstances warranted.

One major appeal was pending during 1966 concerning the assessment of the New Liskeard sewage lagoon, but no appointment for a tax appeal hearing was obtained before the end of the year.

A review was also undertaken of Commission liability for Provincially-owned works.

Southern Peel County Area Water & Sewage Works Programs

Preliminary property investigations were undertaken in connection with this Provincial program and two major sites were acquired.

The statistics for the Branch are as follows:

STATISTICS

PROPERTIES

Properties under negotiation at end of December 1965 ...	53
New properties listed for acquisition during 1966	57
Options obtained or property otherwise acquired	
during 1966	75
Properties under negotiation at December 1966	35

OPTIONS

Options held at end of December 1965	281
New options acquired during 1966	67
Deals completed during 1966	180
Options outstanding at December 1966	168

Division of Research

A. J. HARRIS, *Director*

The Division of Research co-ordinates under one responsibility the applied research of the Commission with respect to water resource topics concerned with the quality, supply and purification of water, the biological and chemical hazards and the control and treatment of sewage and industrial waste waters.

Field Projects Branch

The Field Projects Branch function is to evaluate processes and the application of theory in non-specific engineering problems, and to develop design criteria which will improve the knowledge and practical application of water and waste-water treatment methods. The projects undertaken are normally of a long-term nature involving laboratory models and field pilot plant installations.

Projects include nutrient removal from sewage effluents, effluent polishing evaluation, effect of algae on gravity filters, high rate water filtration processes and nitrogen requirements in waste treatment.

Scientific and technical personnel include those from the chemical, civil, mechanical and physics fields.

SUMMARY OF ACTIVITIES

During 1966 reorganization of the Branch was completed and the full authorized staff complement obtained. In addition to chemical and instrumentation technicians the staff now includes personnel with degrees in civil, mechanical and chemical engineering and in physics.

Members of staff participated in advanced training courses both at the technical and professional level.

The program of the Branch included not only the continuation of previously initiated projects but also the initiation of new projects involving both field pilot plants and laboratory model studies. Completion of projects resulted in the publication of seven reports.

A resumé of the 1966 Branch program is presented below.

High Rate Water Filtration

Proposals were received by the Commission for the installation of high rate water filters in municipal water treatment plants in the Province, and, prior to acceptance of such systems, the Division of Research was commissioned to carry out an evaluation of the process. This was done by staff of the Field Projects Branch through a literature search and inspection of operating installations in Northwest U.S.A.

Effect of Algae on Water Filtration Systems

A laboratory model was constructed to simulate water filtration systems currently in use and an algae-laden raw water was applied to these filters. Filter media consisted of conventional rapid-sand beds, anthrafilt, and dual-media. The efficiency of algal removal and rate of filter impairment of each type of filter, when subjected to raw water containing varying amounts of the algae *Chlorella* and *Scenedesmus*, was evaluated. Testing is continuing into 1967.

Pleasure Boat Toilet Facilities

The Branch continued its work on the establishment of design criteria for pleasure boat toilets. A regulation has been passed under the OWRC Act of regulations governing the design and use of such facilities.

High Rate - Combined Tank Activated Sludge Process

An evaluation was made of three high rate-combined tank activated sludge process designs (Rapid Bloc, Oxycontact and Aero-accelerator). The study involved a literature search and inspection of existing installations in the Province of Quebec.

A report is being prepared, the purpose of which is to guide the OWRC in considering proposals for construction of such facilities in Ontario.

Effluent Polishing Evaluation

In view of the necessity of providing, in many cases, sewage treatment of a degree higher than that obtainable from standard secondary treatment facilities, the Branch has undertaken an evaluation of various existing effluent polishing processes. The study is being conducted in the form of both a literature review and a field evaluation of existing installations. The program is continuing.

Tertiary Treatment — Brampton

The results of a study program initiated in August 1964 and concluded in December 1965 were evaluated during the early part of 1966 and a report of the findings presented.

The pilot plant facilities consisted of two ponds which could be operated separately, in parallel, or in series. One pond contained aeration devices.

Supplementary Aeration of Waste Stabilization Ponds

The project, initiated in May 1965, was completed during 1966. The program consisted of an evaluation of an aeration pond-lagoon system for the treatment of combined industrial and domestic wastes.

Studies were carried out from a field laboratory established at the test site (Sandwich West, near Windsor) and extended over spring, summer and fall periods with inspections carried out during the winter.

A report was prepared at the conclusion of the field work.

Nutrient Removal by Algae

A common tertiary treatment facility consists of a lagoon connected in series to a secondary sewage treatment plant. Algal production in such a lagoon is abundant and the effects of such algae in reducing the amount of soluble phosphate were not known. Various reporters have published results indicating removal figures of up to 50 per cent. Preliminary studies in the OWRC laboratory indicate a variable reduction with removals in the range of 3 per cent under some conditions. Work is continuing on this project.

Sewage Effluent Diffusion

In 1965 a study of the efficacy of fresh water outfall disposal of water-borne wastes was carried out through 1965 and 1966.

The study was initiated to determine the most efficient design and location of waste outfalls and water intakes in large bodies of fresh water. Papers describing the implications of such disposal, and the mixing and diffusion characteristics of the Lakeview STP outfall, were prepared.

The Great Lakes Institute is conducting an inshore circulation study of the Toronto waterfront area on a research grant as part of this study. This portion of the program is continuing into 1967.

Sludge Lagooning

The evaluation of deep lagoons used for thickening and/or drying digested sludge was completed, and a report on this subject was prepared during 1966. This study, carried out on a pilot plant installation constructed at the Lakeview Sewage Treatment Plant, had been initiated in 1964. The results of the study indicated that deep lagoons are not effective in producing a dried sludge but are useful as sludge thickeners, thus reducing the volume for, and therefore costs of, ultimate disposal.

Berm Erosion Control

The investigation of wave erosion on waste stabilization pond berms was initiated in late 1964, and both field and laboratory studies continued through 1965 into the early part of 1966. The results of the tests were compiled, and a report was issued in May 1966. This report included methods of predicting wave heights and erosion rates and also included recommendations for the modification of existing design criteria to produce more erosion resistant installations.

Catch Basin Efficiency Evaluation

At the request of the Ontario Department of Highways, and with the approval of the Commission, the Branch has undertaken an evaluation of varying catch basin grating designs to determine interception efficiencies. A flume has been constructed in the test area, and testing is currently being carried out with an expected completion date early in 1967.

In addition to the foregoing programs, the Branch was also involved in studies of methods of phosphate removal from secondary sewage treatment plants, evaluation of the effects of organic coagulants, the use of a model Sewage Treatment Plant to investigate the effects of trade wastes on activated sludge, a literature review of sludge dewatering methods, and an evaluation of the use of Zeta potential measurements in water treatment.

The Branch also acted in an advisory capacity to the City Engineers Association and other Divisions within the Commission.

Technical Advisory Services Branch

The Technical Advisory Services Branch becomes involved in the evaluation of both equipment and processes which are of direct interest to the Commission. Field activities include:

- investigation of treatment process, and operating problems at water and waste-water treatment plants,
- monitoring of the performance of water and waste-water treatment processes over extended periods,
- proof testing of equipment installed in newly built water and waste-water plants prior to acceptance of the equipment.

This work is done in co-operation with the consulting engineer and the equipment supplier.

Personnel with a chemical background predominate and there are specialists in water, sewage and industrial waste treatment processes in the Branch. The problems handled deal mainly with the chemical processes.

SUMMARY OF ACTIVITIES

Most of the year's activities were of a routine nature, assisting other groups and divisions of the Commission to solve operating problems in water and waste-water treatment processes at treatment works in Ontario, and the evaluation of equipment and processes used for the treatment of water and for waste water.

This Branch became involved in several Provincial projects,

being requested to determine, by means of bench-scale studies, a suitable method of treatment for a particular water supply and for several combinations of domestic and industrial wastes. Throughout the year, a significant number of other bench-scale studies were also carried out.

The various activities are summarized under three main headings: a) water purification, b) waste-water treatment, c) branch laboratory section.

Water Purification

The most frequently recurring problem, as in previous years, concerned objectionable taste and odour in waste supplies and this Branch investigated 15 such reports for municipalities. Most of these problems occurred during the hot summer period when surface water supplies were often heavily infested with taste-producing and odour-producing algae. It is interesting to note that only two of these reports involved communities drawing water from the Lake St. Clair-Lake Erie region.

Taste and odour problems in some ways are among the most frustrating encountered by the Branch. In extremely hot weather certain species of algae can multiply at a fantastic rate and produce highly objectionable odours. Within a matter of hours or a day, a thunderstorm could disperse the algae from the shallows of the lake so thoroughly that only a trace of odour is detectable when an OWRC representative arrives.

The second largest group of problems may be categorized under plant operation. This group includes such problems as corrosion, improper chlorination, chemical feeding, and such specialized treatment processes as recarbonation of softened water. Most of these problems involved small municipal plants which employed operators who had no special training in the chemistry of water treatment.

As part of preliminary work on a Provincial Water Supply System serving the Haileybury region, a detailed study was conducted on water from Lake Timiskaming, which is highly coloured and soft. Conventional treatment processes could not

produce a water of acceptable quality. Test results will be used in the design of the treatment system.

Bench-scale tests were carried out at London to observe the effects of mixing water from the existing wells with treated water from Lake Huron. The quality of the mixed samples was generally acceptable.

A small well-supply serving a subdivision near Markham was sampled regularly to determine whether polyphosphate treatment was effective in the prevention of iron staining.

Waste-water Treatment

The measurement of oxygen transfer in aeration tanks continued to be a major activity throughout the year. Coarse bubble air-diffusers were tested at the Brampton, Brantford, Elora and Vaughan Township WPCP's. The measured transfer efficiency ranged from three to four per cent. When tested under conditions of simulated design loading at the Elora WPCP, the coarse bubble air-diffusers could not maintain the required dissolved oxygen content. A series of proof tests at the aerated lagoon serving Durham led to the acceptance of the mechanical surface aerators.

Extensive assistance was provided in the operation of the Elmira WPCP, especially of the activated sludge process. Eventually it proved possible to achieve a reasonably satisfactory operating procedure using detailed laboratory control tests.

Two aerated lagoons treating industrial wastes (near Alliston and Kettleby) were again sampled at regular intervals. Treatment efficiency at Kettleby remained at a high level during the winter. The red-purple colour observed in the Alliston lagoons in the fall was caused by a species of sulphur bacteria.

For the first time in Ontario, two oxidation ditch plants were put into operation. The plant serving a food processing industry in Tilbury showed satisfactory performance. Oxygen transfer tests were conducted at the Warkworth Institution.

A sampling survey of anaerobic sludge digesters at treatment plants in the Toronto area was undertaken to provide basic in-

formation on the various factors influencing the digestion process. As a result, correction of operating problems might be simplified. During the year, digester operating problems were investigated at six treatment plants, among which were the Port Hope and Timmins WPCP's.

At three treatment plants, tests were carried out to improve the operation of rectangular final clarifiers using an energy-dissipating baffle. A definite improvement was observed at the Elora WPCP only.

In addition to the routine and special field investigations, a considerable amount of time was spent on bench-scale studies in the laboratory to determine the treatability of various industrial wastes by biological processes. In some instances the purpose was to observe the effects of waste water on the existing treatment process. Samples of waste water from a winery, a maple sugar processing plant, a chemical process industry and a textile mill were studied.

Two bench-scale studies were conducted as part of preliminary work on Provincial projects at Hespeler and Thornbury. At Hespeler, more than 60 per cent of the total waste flow originates in the local industries. At Thornbury an apple processing plant operates for only two months every year. The test results will be used by the consulting engineers in their design of the treatment works.

A series of laboratory tests on samples of waste water from a paper-converting industry in Georgetown yielded several recommendations for improvement of their chemical pretreatment process. The treated wastes are discharged to the Georgetown WPCP.

Miscellaneous activities included monitoring of the pH of untreated waste water at the Cobourg WPCP and analysis of wastes from coin-operated car-wash installations.

Laboratory Section

Several pH meters were evaluated. Two instruments were selected for reliable use in the field because both could be operated on

a battery or from a 110-volt line outlet. Two pH meters with an expanded scale were examined for use with specific ion electrodes.

A portable water analysis kit was evaluated. It proved suitable for field use. This kit includes nearly all methods of analysis normally applied to water supplies.

A number of methods for fluoride as well as residual chlorine were evaluated. Each of these methods had been specially designed for use by water works personnel.

Modified methods for chemical oxygen demand and for volatile acids were tested to determine whether they would be more suitable as field techniques than the ones currently in use.

Good results were achieved with the dissolved oxygen meter equipped with a high-capacity membrane-covered probe. This meter was also used quite successfully with a recorder. However as in previous years, a considerable amount of time was required for maintenance and calibration of the measuring instruments, including this DO meter.

The following numerical summary may give an indication of the analytical activity of the laboratory section:

Number of samples received in the laboratory	1,139
Number of determinations made in the laboratory	6,884
Number of determinations made in the field	4,895
<hr/>	
Total determinations 11,779	

The samples received in the laboratory were taken by field staff of this Branch in the course of their field investigations. The determinations carried out in the laboratory include analyses of the samples received, as well as of samples from bench-scale studies in the laboratory.

Special Studies Branch

The Special Studies Branch carries on research into lake and stream pollution and treatment processes which require special investigations, mainly of a non-engineering nature. Studies involve the waste and decomposition products of algae, bacteria, actinomycetes, etc., which create taste, odour or toxic conditions in water supplies, the effect of pollution on aquatic plants and animals, the development of methods for the isolation and identification of water-borne animal viruses and organic pollutants, the effect of sewage discharge on receiving waters and the control measures for *Cladophora* in the Great Lakes.

Staff includes scientists up to the Ph.D. level in biology, microbiology, chemistry and plant physiology.

SUMMARY OF ACTIVITIES

The Special Studies Branch is responsible for carrying out comprehensive sophisticated research into those areas of water management involving algae, bacteria, viruses, chemical analysis, and macroinvertebrates. Investigations, both at the laboratory and in the field, involve a wide range of routine and non-routine techniques, for example: the use of viruses, radioactive labelled compounds, pure cultures of organisms, various chromatographic and instrument analyses. During the past year the work was subdivided into the following four sections – Botany, Chemistry, Microbiology and Virology, and Zoology. Programs undertaken by these sections during the past year are listed below and give some idea as to the diversity of the research being carried out. Personnel of the branch also maintain a close liaison at the technical level with the staffs of nearby universities and with representatives of other organizations active in water management such as the National Research Council, the Great Lakes Institute, and the International Biological Productivity Program.

BOTANY

Primary Productivity Study

During 1965 and 1966 a comprehensive investigation was carried out into the algal productivity of Quirke and Dunlop Lakes in the Elliot Lake region. The former receives limited quantities of acid mine drainage; the latter does not. Although analyses for 1966 are not yet complete, differences between the two lakes are evident. Productivity measurements, based on the incorporation of radioactive bicarbonate by algae, standing crop estimates, as well as chemical and physical data, suggest that productivity in Quirke Lake is lower than in Dunlop. This reduction may not be just a result of inherent characteristics between the lakes but may be due to the effects of entering materials which have substantially altered the environment of Quirke Lake.

Pesticide Studies

Relationships between three insecticides – DDT, Sevin, Malathion – and the alga *Chlorella* were investigated. From experiments involving the effects of the chemicals on algal growth, it was observed that concentrations of DDT up to 100 ppm had no appreciable effects, whereas concentrations of Sevin and Malathion exceeding 1 ppm inhibited the growth of the alga up to 20 per cent over a seven-day period. Increasing the pH of cultures from 6.0 to 9.0 increased the toxicity of Malathion, whereas the reverse was true with Sevin. Possible degradation of the insecticides to less toxic materials by algal metabolic processes was investigated using radioactive labelled compounds. During a 24-hour exposure period, little conversion of any of the insecticides occurred. Tests on metabolic breakdown over a longer period of up to at least seven days are now in progress. As the solubility of these compounds in water is quite low, eg., DDT = 1.2 ppb., it is not surprising that little uptake and conversion occurred during a 24-hour period.

CLADOPHORA STUDIES

1) Thermal Bar – *Cladophora* Relationships

During 1966 investigations were carried out to observe whether a correlation may exist between the persistence of a "thermal bar" – a zone of water at 4°C which develops near the shore of Lake Ontario in the spring – and the growth of the algae *Cladophora* in June and July. It is postulated that the "bar", which disappears in mid-June, may create a highly nutritive on-shore zone by restricting the diffusion of river discharges, etc., outward to the lake. The increased availability of nutrients would stimulate excessive *Cladophora* growth. If such a relationship exists, the development and persistence of the thermal bar in early spring might well act as an indicator for the necessity of aquatic weed-control practices later in the spring and summer. In 1966 *Cladophora* was not as serious a problem as in previous years nor was there a strong development of the thermal bar.

2) Aquatic Weed Control

During July and August of 1966 two large scale trials using Hydrothol were conducted.

The first test application involved the use of granular Hydrothol applied over a test plot approximately 2,000 feet long and 400 feet wide along the shore of Lake Ontario near Oakville. Application was made from an aircraft. Underwater inspection of the test plot by staff of the Field Projects Branch before and after the treatment did not indicate any significant kill.

The second trial, conducted in co-operation with the British-American Oil Company and the chemical manufacturer, involved an application of liquid Hydrothol from a boat at a dosage of 1 ppm active ingredient over an area approximately 4,000 by 400 feet in size. The water temperature at the time of application was 50°F which is well below the optimum for the chemical reaction. Little effect was seen for five days, after which time the water temperature rose to 65°F and a 90 per cent die-off of *Cladophora* was evident. This test was not considered conclusive.

Water Movement and Phytoplankton

Preliminary field observations in 1965 showed that when the effluent from an oxidation lagoon, high in dissolved oxygen, entered a stream also high in dissolved oxygen, a low oxygen mixture resulted. Inasmuch as the predominant flora in lagoon discharge is algae, it is possible that the velocity of the receiving stream may have had some detrimental effect on oxygen production by the algae. Laboratory studies to investigate this phenomenon, still in progress, suggest that when algae are driven at velocities greater than 3 feet/second there is in fact a severe reduction in the oxygen-producing capabilities of the phytoplankton.

Taste and Odour Studies

Discussions were held with the Divisions of Laboratories and Sanitary Engineering concerning the extent of the problem of tastes and odours in water supplies, and a suitable joint program was developed. Preliminary attempts to culture certain types of algae associated with this problem, particularly flagellated species, are in progress. Future research will involve the isolation and identification of compounds obtained from pure culture of these organisms and the correlation of this information with field problems.

CHEMISTRY

Organic Industrial Wastes Studies

Discussions were held with personnel of the Division of Industrial Wastes concerning the necessity for developing better parameters for evaluating organic discharges from various groups of industries. Considerable review literature and a limited number of on-site field trips have been carried out. Experimental investigations into this complex area of study are to begin shortly.

MICROBIOLOGY AND VIROLOGY

Bacteria and Fluorides

Relationships between sodium fluoride and bacteria, typically used as indicator organisms of pollution, were carried out. The results showed that this chemical had no deleterious effects on these organisms except at extremely high concentrations.

Virus Removal in Lagoons

During 1965 and early in 1966 a pilot study was set up to investigate the efficiency of virus removal (poliovirus) by a model sewage lagoon. The study lasted 20 weeks and was supported by laboratory tests with samples from the Bradford lagoon. At no time did the virus, fed to the model lagoon at the rate of five million units/day, appear in the lagoon effluent. The results of the investigations have been released in Research Report No. 9 and have also been submitted for journal publication.

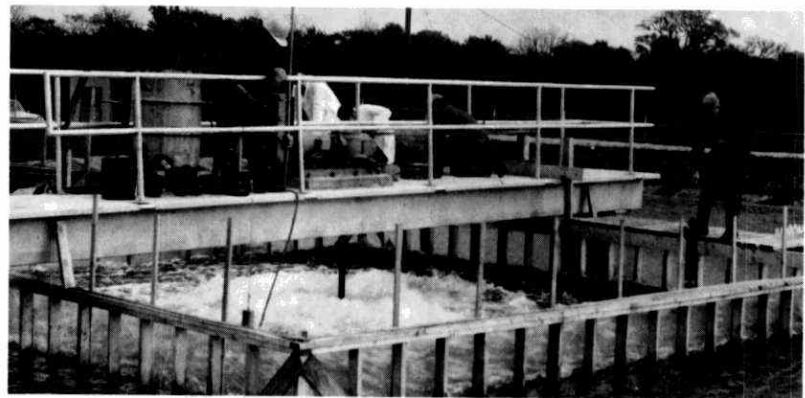
Virus Recovery Experiments

Various methods of recovering viruses, both bacteriophage and animal, were investigated in the hope of developing an efficient but relatively inexpensive procedure. Preliminary investigations suggest that a recovery system involving a filter membrane and a monkey-kidney tissue culture may be promising.

ZOOLOGY

Benthos Studies

A preliminary survey was conducted in the spring of 1966 in the Bay of Quinte to provide background material for more intensive surveys in the summers of 1967 and 1968. The major objective of this study is to relate characteristics of macroinvertebrate communities of the sediments to water quality estimates.



Mechanical aerators are evaluated with this apparatus at Durham.

Division of Sanitary Engineering

J. R. BARR, *Director* G. R. TREWIN, *Assistant Director*

The programs of the Division of Sanitary Engineering are divided into five main categories: (1) the evaluation of plans of proposed water supply and wastewater treatment installations, (2) the inspection, promoting and supervision of water and waste-water treatment plants in the Province, (3) the study and control of pollution in the waterways of Ontario and the monitoring of water quality in both the Great Lakes and other waters in and surrounding the Province, (4) the supervision of plumbing and the control of pollution from water craft, and (5) the planning of regional water supply and waste-water treatment facilities.

The five programs are organized and performed by five operating branches. In addition, the Administration Branch directs the Division's activities and provides two staff functions, namely the planning of the Division's water works program and the sewage works program.

During the year an additional program was added, the planning of regional water supply and waste-water treatment facilities. Also, with the recruitment of staff for the Great Lakes program, the complement was filled late in 1965 and the monitoring program was greatly expanded during the summer of 1966.

Design Approvals Branch

The Branch appraised engineering reports, plans and specifications submitted for the approval of water works, sewage works and certain industrial waste treatment installations in accordance with Sections 30 and 31 of the ONTARIO WATER RESOURCES COMMISSION ACT.

Recommendations were made to the Ontario Department of Municipal Affairs on water and sewage works requirements for

subdivision draft plans and official plans submitted in accordance with Sections 26 and 12 of the Planning Act.

Requests for information from the public and other government agencies, as well as special assignments from the Commission, were handled by the Branch.

The statistical section recorded chemical and bacteriological analyses results submitted by the OWRC and the Ontario Department of Health laboratories.

The clerical section prepared and handled the approval certificates for those applications processed by the Division of Industrial Wastes.

Special Assignments

The Branch repeated its fluoridation survey of all municipalities which use controlled fluoridation. This year the survey was extended to obtain capital as well as operating costs.

The tabulation of water and sewage works requirements in the Province was updated. A complete list of municipal and private waterworks in the Province was prepared.

A technical paper was prepared, "Water Supply and Sewage Treatment in Canada", for presentation at the Ninth Congress of Union Panamericana de Ingenieros. The Division of Construction and the Division of Plant Operations are co-operating with the Design Approvals Branch in the preparation of a booklet on the selection and design of sewage pumping stations. This booklet will be available for distribution to engineers and architects in 1967.

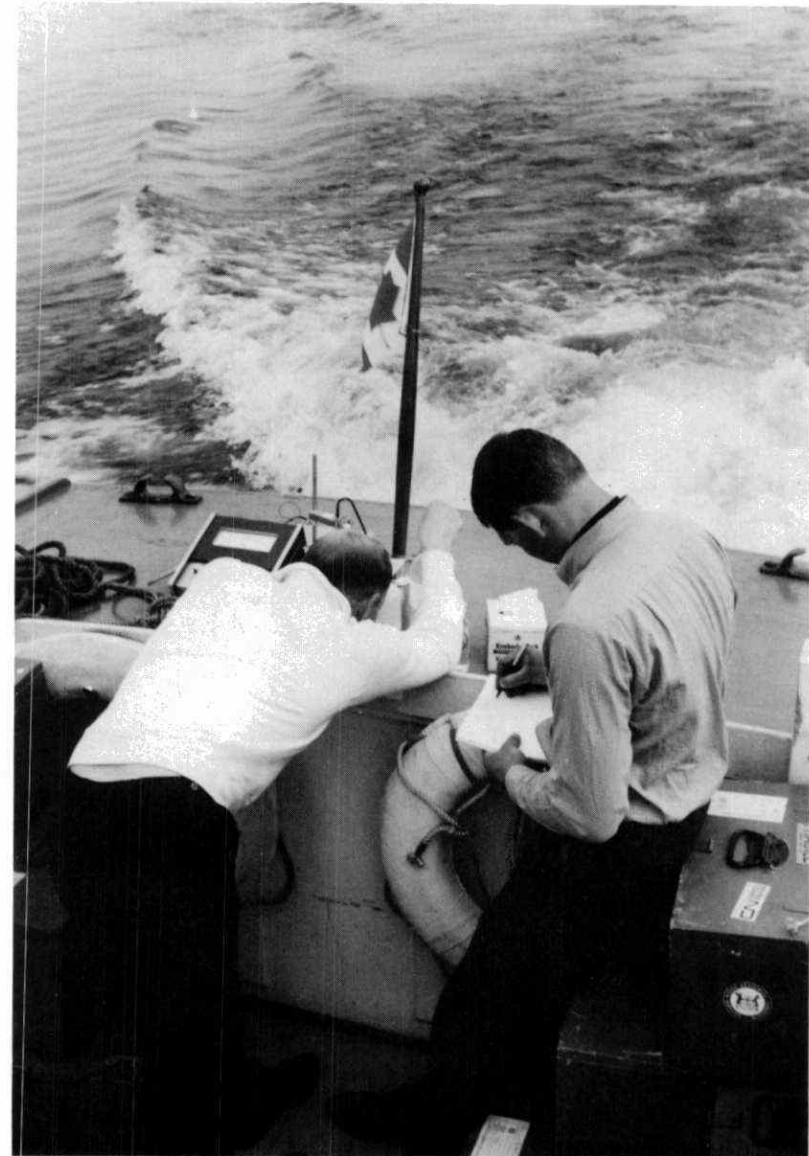
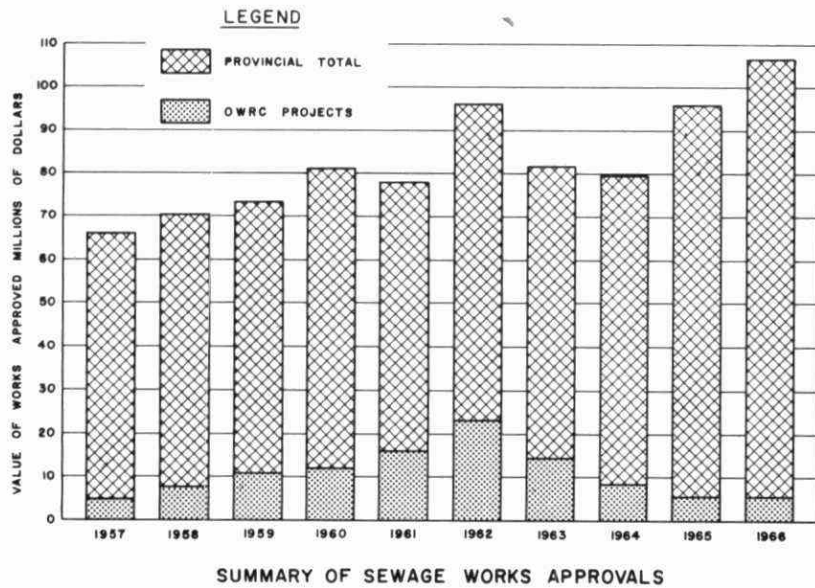
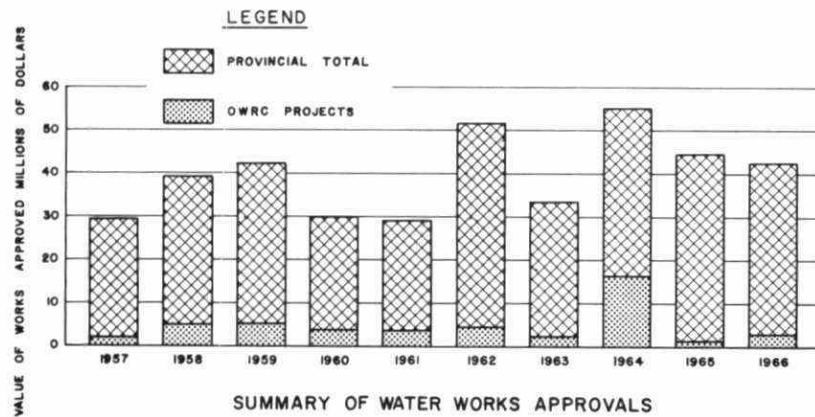
A visit was made to a number of "Rapid Bloc" type activated sludge sewage treatment plants in the Province of Quebec.

Certificates of Approval

During the year the branch processed 2,607 applications, subdivision reviews and engineering reports.

These resulted in a total of 1,842 certificates of approval at a total estimated cost of \$152,996,319. In 1965, 1,753 certificates were issued for water works, sewage works and industrial waste facilities at a total estimated expenditure of \$140,445,692.

DIVISION OF SANITARY ENGINEERING
DESIGN APPROVALS BRANCH



Technicians are seen carrying out field chemical tests aboard *M.V. Pelican* on Detroit River.

Certificates issued for water works applications totalled 763 and involved an estimated expenditure of \$42,321,229 compared with 721 certificates and an expenditure of \$44,526,957 for 1965.

In the waste-water field 1,079 certificates were issued during the year at an estimated cost of \$106,675,090, against 1,032 approvals in 1965 at an estimated cost of \$95,918,735.

Of the total certificates issued in 1966, 31 were for OWRC water works projects, and 43 were for OWRC sewage works projects. Estimated costs of the projects were \$3,499,218 for sewage works and \$2,932,639 for water works.

Certificates for works to be constructed under Provincial financing issued in 1966 were as follows:

PROVINCIAL PROJECTS

WATER WORKS	ESTIMATED COST
Lake Erie Water Supply System	\$7,563,000
Moosonee Townsite (first stage)	45,550
SEWAGE WORKS	
Beaverton	+596,000
Beeton	+101,521
Cornwall	5,935,800
Moosonee Townsite (first stage)	133,800
Woodbridge	372,132

District Engineers Branch

GENERAL

The field work continued to be carried out under the supervision of four district engineers, each of whom covered designated areas in southern and northern Ontario. In this work, inspections were made in every part of the Province. The routine work involved water-pollution surveys and the inspection of industrial-waste disposal at canning factories, milk plants, and other food-processing plants, as well as the inspection of water works and sewage-treatment plants throughout the Province.

In addition to the routine work, special investigations requested by municipalities, the public, or senior staff of the Commission continued to contribute largely to the work of the Division.

Water Works Inspection

There were 1,484 routine and special inspections made of water treatment plants by the district staff. This can be compared with a total of 1,376 for 1965. Samples, totalling 2,922 bacterial and 2,058 chemical, were secured during the water works inspections. The number of recorded water works inspection points increased from 799 in 1965 to 1,023 in 1966, indicating the need for an increased number of inspections each year. The greater part of this increase is due to an expansion of the program to provide assessments of a larger number of summer water works. The yearly inspection objective for the program was three visits for the following water works: chlorinated municipal, year-round-private and industrial (including mines) with townsites, with one visit for systems not requiring disinfection, as well as summer-private and industrial (including mines) not having townsites. During 1966, 1,311 inspections were made of the routine inspection points.

Waste-water Treatment Works

There were 1,463 routine and special inspections made during 1966 of waste-water treatment works serving municipalities and industry. These compare with 2,083 inspections made in 1965. A total of 887 bacterial and 2,162 chemical samples were obtained while making these inspections. The transfer of part of the program to the Division of Industrial Wastes accounts for the decrease in the number of inspections.

The inspection objective for waste-water treatment facilities was three visits a year for secondary municipal sewage treatment plants, one inspection for septic tank facilities, with two inspections per year for industrial waste-water treatment installations and primary municipal sewage treatment plants.

**(1) Sewage Treatment Plants
and Septic Tank Installations**

There were 645 routine inspections of sewage treatment plants and septic tank systems. The number of inspection points has steadily increased from 328 in 1962 to 431 points in 1966.

(2) Canneries

There were 98 inspections made of canneries where the objective is two inspections per year. The number of canneries in operation decreased from 82 in 1962 to 67 in 1966.

(3) Milk Plants

During 1966, 97 inspections were made of the treatment facilities serving 278 milk plants. The number of plants decreased from 316 in 1964 to 278 in 1965, indicating a continuing trend toward consolidation. The program has been transferred to the Division of Industrial Wastes.

(4) Meat Plants

Eighty-four inspections were made of the waste-water treatment facilities serving 214 meat-processing plants. This program has been transferred to the Division of Industrial Wastes.

(5) Other Industrial Waste Plants

Miscellaneous waste-water treatment facilities serving gravel-washing plants and other non-chemical industries were inspected by the staff of the Branch. During the year, 34 inspections were made.

**MUNICIPAL WATER POLLUTION AND
WATER QUALITY SURVEYS**

In controlling pollution the field staff performed 58 municipal water pollution surveys. The surveys are designed to locate pollution points and promote the collection and treatment of the offending waste-water discharges.

There were 38 water quality surveys performed. This type of survey is intended to evaluate the effect of waste-water discharges on the quality of water.

MISCELLANEOUS

(1) Meetings with Municipal Officials

The staff of the District Engineers Branch continued to have more direct contact with water works and sewage works officials and personnel throughout the Province. During 1966 there were 18 meetings with public utilities commissions and 74 with municipal councils. In addition, discussions were held with various municipal officials and were duly recorded. In this field there were 459 discussions with municipal clerks, 491 with various other municipal officials, 229 with public utilities commission staff, 103 with consulting engineers, 690 with health officials and 679 with other entities. This is an important aspect of the activities of the Division as it brings about a direct contact between local officials and the Commission in promoting the installation of necessary water and sewage works facilities.

(2) Special Investigations

Special investigations requested by municipalities, the public or senior staff of the Commission are a part of the work of the Division of Sanitary Engineering. A total of 857 of these requests were received and completed.

Plumbing and Boating Branch

(1) Plumbing Program

All phases of the 1965 plumbing program were continued in 1966.

The Plumbing Inspectors Association has divided the Province into eight zones. Five zone meetings were held in 1966 with some zones holding joint meetings. In addition, three meetings were held with plumbing contractors for the purpose of familiarizing the contractors with the revised Plumbing Regulation.

A number of amendments were made to the Plumbing Regulation. The changes were so extensive that it was decided to consolidate the 1966 and 1964 amendments with the Regulation and to publish a new consolidation for use in the industry.

One major change in the Regulation permits the wider use of plastic materials; the manufacturing specifications were not written into the Regulation, but compliance with The Canadian Standards Association is required. This principle, which provides laboratory control over plastic plumbing materials, could be extended to cover other materials if it is found workable.

The Canadian Standards Association sponsored a meeting to review the feasibility of creating a nation-wide plumbing council to promote better liaison between provincial plumbing authorities. The Plumbing Branch represented the Province of Ontario at the meeting.

(2) Boating Program

A regulation was adopted which will place restrictions on the discharge of wastes from pleasure boats. This regulation has already attracted wide public interest.

Water Quality Surveys Branch

The Water Quality Surveys Branch was responsible for engineering surveys in the water quality management program in Ontario. Investigations supervised by the Branch included:

- (a) pollution source and water quality inventory programs (rivers, lakes, etc.),
- (b) definition of water quality goals,
- (c) determination of acceptable waste-water loading and quality forecasts, and
- (d) monitoring to establish stream loadings and changes in lakes related to use practices and variations in quality with variations in time.

Reports prepared by the District Engineers Branch on the inventory of pollution sources, including solid-waste disposal practices, were submitted to 70 municipalities. The reports, entitled Water Pollution Surveys, were distributed to municipalities, industries, conservation authorities, consulting engineers and

others, and formed the basis for the development of local pollution control programs.

As part of the pollution surveillance program, several aerial patrols were made during the year in areas of heavy water-use. Emphasis was placed on the major river basins and the shore waters of the Great Lakes. Offending sources of pollution were brought to the attention of the parties responsible and corrective action initiated.

Detailed engineering surveys and quality forecasts were carried out under the River Basins Surveys and Great Lakes Surveys programs. These investigation programs are designed to provide guidelines for planning water quality controls in the river basins contributing to the major drainage systems, including the Great Lakes. While the quality analysis technology is reasonably well understood in relation to streams, application this year was limited to short sections of rivers.

The approach to the Great Lakes was more basic and keyed to the information needs of the International Joint Commission. Although a good part of the pollution-source inventory work has been completed by the Ontario Water Resources Commission in municipalities adjacent to the lakes, this information requires updating and review to arrive at the necessary estimates of waste loadings being introduced to the lakes. During the course of the IJC Great Lakes inventory program, OWRC study and forecast programs related to waste-treatment system-design requirements, are being improved and developed.

The various survey programs were supported by the drafting section which also serves other Commission Branches and Divisions. Work included engineering drawings and tracings, maps, graphs, charts and diagrams.

River Basins Surveys

The activities of the River Basins Surveys are divided into the following water quality control programs:

1. WATER QUALITY MONITORING
2. WATER QUALITY ANALYSIS AND FORECASTS.

The Water Quality Monitoring Program, designed to provide quality data on monthly, seasonal and annual variations at selected sampling stations throughout the Province, expanded by 50 per cent in 1966 to a total of 300 monitoring stations. Sample collection, normally scheduled on a monthly basis, was increased to a bi-weekly frequency on streams directly tributary to the Great Lakes. As in previous years, conservation authorities and the Department of Health co-operated in the sampling program. Co-operative water study programs were carried out with the assistance of the Maitland Valley Authority, the Moira River Authority, the Credit Valley Authority, the Holland River Authority, the Halton Region Authority, the North Grey Region Authority, the South Nation River Authority, the Metropolitan Toronto and Region Authority, the Saugeen Valley Authority, the Ausable River Authority, the Cataraqui River Authority and the Otonabee Region Authority.

Regular sampling was also carried out by the City of London on the Thames River and by the Metropolitan Toronto Department of Works on the Don River.

The Water Quality Analysis and Forecast Program is designed to define the self-purification capacity of streams in the assimilation of waste water. Analysis of field data enables the development of mathematical models which permit the forecast of water quality variations under specific conditions of waste-water loading, water temperature and stream flows.

During 1966 four waste-water assimilation studies were performed:

- the Holland River from Aurora (Aurora Creek) to Newmarket;
- the Holland River from Newmarket to the confluence with Schomberg River;
- the Kettle Creek downstream from St. Thomas to Lake Erie;
- the Credit River downstream from Orangeville.

The latter study was performed to supplement information collected during 1965. Preliminary surveys to serve as a basis for

planning future investigations were carried out on the Don River (Metropolitan Toronto) and the Rideau River downstream from Smiths Falls. The Middle Maitland River was studied to estimate the acceptable waste-water loading to be used in the design of improved sewage treatment for the Town of Listowel. Preliminary assessments of the acceptability of the Rouge, Don, Humber, Holland and Bonnechere rivers to receive waste loadings were made.

Special investigations included a water-quality survey of the Kam River (Fort William), sediment sampling in the Lower Don River including portions of Toronto Harbour and other problem areas.

Radiological Program

This program was initiated during 1966 to define the extent to which mine and mill wastes have spread into the Elliot Lake-Serpent River Basin and the Crowe and Eels basins in the Bancroft area. The work will determine the possible effects which radioactivity may have on the physical, chemical and biological characteristics of the waters and sediments of the lakes and rivers in these districts. The investigation will lead to guidelines for use in improving uranium-mining waste management and the disposal of radioactive tailings.

Great Lakes Surveys

The survey program was designed to establish the areal distribution and seasonal variations of physical, chemical and bacteriological characteristics of lake water. This information, together with specialized local studies on waste movement and decay, will provide a basis for the forecasting of pollution control requirements at locations along the lakes and within the tributary drainage basins.

The field work was expanded during the past year in keeping with the 1965 International Joint Commission Reference on Lake Erie, Lake Ontario and the International section of the St. Lawrence River. The program was co-ordinated with Canadian federal agencies involved in the IJC studies including the Depart-

ment of National Health and Welfare and the Department of Energy, Mines and Resources.

Four survey vessels (*Lac Vancouver*, *Sparks*, *Pelican*, *Jackfish*) equipped with laboratory facilities and related instrumentation, were employed during the past season. The laboratory facilities on the vessels were supported by land-based laboratories at Toronto and London.

Lake Ontario survey operations extended from May 16 to October 29 and were carried out by the 65-foot *M. V. Lac Vancouver*. The sampling program included the waters from the upper Niagara River through Lake Ontario to the Bay of Quinte. Seven monitor cruises and a detailed reconnaissance survey were carried out in these waters.

Preliminary harbour and river dispersion studies were carried out at Port Hope, Picton, Belleville, Trenton, Cobourg, Oshawa, Hamilton, Toronto, Clarkson, the Credit River, Don River and Twelve Mile Creek. These studies provided information on the dilution and decay of waste materials discharged by the rivers and waste sources in harbour areas.

Lake Erie survey operations extended from May 9 until November 14 and were carried out by the 42-foot *M. V. Sparks*. The various surveys covered the northern shore waters of the lake from Toledo in the west to the upper Niagara River in the east. Five monitor and two detailed cruises were completed along the north shore. In addition, IJC station locations in western Lake Erie were occupied on five occasions. Preliminary studies were carried out at Port Stanley, Port Dover, Port Burwell, Port Colborne, Leamington, Rondeau Harbour, Wheatley Harbour, Port Maitland and at the mouth of the Grand River.

Survey operations on the Detroit River, St. Clair River, St. Marys River, Lake Huron and Lake St. Clair extended from April 25 to November 14 employing mainly the *M. V. Pelican* and *M. V. Jackfish*. Five synoptic surveys were completed on the St. Clair River, four on the Detroit River and two on the St. Marys River, together with one survey of selected locations off the Lake

Huron coast and on Lake St. Clair. Special preliminary studies at industrial and other waste-water discharge locations were conducted in the Sault Ste. Marie, Windsor and Sarnia areas.

In order to assess trace organic materials present in the waters of the lower lakes and their channels, three carbon absorption units were installed and operated at Sarnia, Port Lambton and Union waterworks.

An inventory of waste discharge points and the quantity of material entering the Boundary Waters was commenced during the year.

The collection of data was geared to computer storage. All the data obtained during the season was recorded in a suitable format and submitted for storage on magnetic tape to the Department of Highways electronic data processing centre. Procedures were started for a preliminary exchange of information through the International Joint Commission.

Regional Services Planning Branch

The Branch was formed in 1966 to study and report on the provision of water supply and pollution control facilities on a regional or watershed (s) basis in developing areas throughout the Province. The functions include: the study of population and land-use trends utilizing planning and development information available from numerous sources to provide projections; the compilation, evaluation and interpretation of surface and ground water resources; the evaluation of existing water supply and pollution control facilities; the determination of future water supply and pollution control requirements; and the presentation of alternate schemes supported by engineering and economic evaluations and other general considerations to provide a basis for recommendations for future works. The reports are prepared for Commission use in planning area schemes.

Two regional studies (three reports) were completed during the year and work was commenced on two other studies. The

County of York, Central Area, Regional Study on Water Supply and Pollution Control, consisted of two reports and was submitted to the Commissioners on July 1, 1966. The Middle Grand River Region Water Supply Study was submitted on November 15, 1966. The Southern Ontario County and Region Water Supply and Pollution Control Study, and the County of Elgin-Southern Area Regional Pollution Control Study commenced in November and December of 1966, respectively. These reports are prepared in co-operation with the divisions of Industrial Wastes, Laboratories and Water Resources.

A schedule of proposed studies up to the end of 1968 has been established.

WATER AND SEWAGE WORKS OPERATORS' COURSES

Intermediate and Senior courses for water works operators were held during the year with attendance of 75 and 72 operators, respectively. Certificates of qualification were issued to the successful candidates completing the three courses of instruction.

There were two courses of instruction for sewage works operators with 111 operators attending the Senior Course and obtaining certificates of qualification and 133 operators attending the Basic Course.

Since the inception of the training courses for water and sewage works operators, certificates of qualification have been granted to 297 sewage works operators and 266 water works operators.



Sampling bottle is shown being removed from the hydrographic line aboard the *M.V. Lac Vancouver*.

Division of Water Resources

K. E. SYMONS, *Director* D. N. JEFFS, *Assistant Director*

In 1966, the Division of Water Resources carried forward established programs concerned with water-resource surveys, test-drilling and well-construction projects, water management, well-construction management, and hydrologic data. Marked expansion of the programs occurred in regional studies of water resources, ground-water surveys and test-drilling contracts as a result of Provincial Projects; in hydrometric networks and drainage basin surveys as a result of northern Ontario water resources studies; and in assessments of hydrogeologic conditions at sites proposed or in use for the disposal of wastes.

The work of the Division was carried forward through four branches. Details of activities are reported herewith by Branch except for those involving centralized service.

Logs on a river in Northern Ontario, to be used by pulp mill, illustrate one form of dependance upon water.

DIVISIONAL ACTIVITIES

Cartography

The cartographic section supported all programs of the Division by preparing maps, charts and diagrams and procuring maps, plans, aerial photographs and mosaics from various sources. The last two multicolour maps for the Big Creek Survey were printed and work was well advanced on similar maps for the Big Otter Creek Survey. A total of 35 single-colour maps was completed in connection with the Synoptic Survey, the Northern Ontario Water Resources Studies, International Hydrologic Decade projects and the water management program. The section also produced charts and diagrams for other projects of the Division and prepared final artwork for display and to augment papers and lectures given by Division members.

ARDA Projects

Reports for three projects, approved for financial support under the Agricultural Rehabilitation and Development Act and initi-



ated in previous years, were in progress. The report on the Synoptic Survey of streamflow measurements was in final draft form. Work continued on the reports of the water resources surveys for the drainage basins of Big Creek and Big Otter Creek.

International Hydrologic Decade Program

Considerable progress was made with two of the three approved International Hydrologic Decade projects. These were Representative River Basin Studies and Assessment of Ground Water. Emphasis was placed on instrumentation to make hydrometric measurements in the five representative basins by the River Basin Research Branch. The Hydrologic Data Branch undertook special ground-water and aquifer testing in two areas and oriented data collected through regular programs to contribute to the assessment of ground water. As originally planned, the Assessment of Surface Water project was carried forward at this time entirely through other established programs.

Members of the Division participated in the work of the Ontario Committee for the International Hydrologic Decade and its scientific and educational subcommittees and in the Eastern Workshop on Representative Basins, the Engineering Hydrology Course at the University of New Brunswick and the Familiarization Seminar on the Principles of Hydrology at the University of Saskatchewan. These were organized in co-operation with the Federal I.H.D. Committee.

Northern Ontario Water Resources Studies

In 1965, an announcement was made of a study of the water resources of Northern Ontario which would include an inventory of the water resources of the basins of the five main rivers discharging to James and Hudson bays as well as study to permit an understanding and evaluation of the factors responsible for the hydrologic characteristics of the region and an assessment of present and future water use. Preliminary planning was coordinated with federal agencies in accordance with guideline developed by the Federal-Provincial Co-ordinating Committee

for Northern Ontario Water Resources Studies. Field work and studies were initiated in 1966.

The Hydrologic Data Branch undertook general hydrologic investigations over the region and maintained close co-operation with the federal Department of Transport and the Department of Energy, Mines and Resources, with respect to the development of hydrometric networks for precipitation and surface water.

Electronic Data Processing

In anticipation of utilizing electronic equipment to process data, one engineer was assigned to a course of training which combined academic training with practical application and development of systems and programs for divisional use.

Educational Activities

The Division was involved in a variety of activities related to the education of staff members and the public. The Division helped to staff five booths at exhibitions. Of these, two dealt entirely with divisional programs. The Division sponsored The Third Water Well Contractors Conference — a two-day meeting designed to promote better ground-water development and well construction. Lectures, talks and formal papers were presented by staff members at a variety of meetings.

Surveys and Projects Branch

The Surveys and Projects Branch was active in five major types of water-resources surveys and water-supply projects: drainage basin surveys, regional studies, municipal hydrogeologic surveys, test-drilling and well-construction projects and special investigations of water-supplies, ground water pollution and land disposal sites. The number of regional studies, municipal hydrogeologic surveys and projects was increased through the new program for Provincial waterworks.

Work completed or in progress included two drainage basin surveys (exclusive of the work associated with the Northern On-

tario Water Resources Studies) 12 municipal hydrogeologic surveys, 13 test-drilling or well-construction projects and 36 special investigations. Table 1 presents a summary of these activities. The number of surveys, investigations and projects is presented graphically in Figure 1.

Drainage Basin Surveys

Completion of the report on the Big Creek Drainage Basin survey was delayed because of reassignment of personnel to other duties. The report was about 50 per cent complete.

The report on the Big Otter Creek Drainage Basin survey was completed in draft form. Review and refinement of the report and maps remained to be completed.

The study of the Attawapiskat River Basin was done under contract by consulting engineers whose work included a study of the stream characteristics; correlation of precipitation, stream-flow and evapotranspiration; and correlation of run-off pattern, storage and snowpack. The field activities have been completed except for the snow-pack measurements. A report was in preparation.

Table 1 — Summary of Surveys and Projects Activities — 1966

ACTIVITY	LOCATION	TYPE OF ACTIVITY		REPORT COMPLETED
		Field	Office	
Drainage Basin Surveys	Big Creek		x	
	Big Otter Creek	x	x	
	Attawapiskat River	by contract		
Regional Studies	County of York-Central Area	x	x	x
	Middle Grand River Region	x	x	x
	County of Ontario-Southern Area	x	x	
	Belleville-Trenton Area		x	x
	Bleazard Valley Region	x	x	

Municipal Hydrogeologic Surveys	Alfred	x		
	Courtland	x	x	x
	Drayton*	x	x	
	Fauquier*	x	x	
	Galt-Preston-Hespeler	x	x	
	Guelph		x	
	Keswick	x	x	
	Latchford*	x	x	
	Mileage 104		x	
	Port Perry	x	x	x
Test Drilling and Well Construction Projects	St. Jacobs	x	x	x
	Vermilion Bay	x	x	
	Brampton		x	x
	Winchester		x	x
	Bourget	x	x	x
	Richmond Hill	x	x	x
	St. Jacobs	x	x	x
	Plattsville*	x	x	
	Callander*	x	x	
	Haliburton*	x		
	Port Perry	x		
	Drayton*		x	
	Bleazard Valley	x		
	Orleans	x		
	Midland		x	

*Provincial Project

Regional Studies

Contributions were made to four reports prepared jointly with the Division of Sanitary Engineering on studies of water supply requirements for four regions in the Province: the County of York-Central Area, the County of Ontario-Southern Area, the Middle Grand River Area and the Belleville-Trenton Area. The Division's studies consisted of an assessment of the availability of regional water resources.

Handwritten notes:
 7 surveys
 13 test-drilling projects
 36 special investigations
 11 projects
 25 maps

DIVISION OF WATER RESOURCES

SURVEYS AND PROJECTS BRANCH

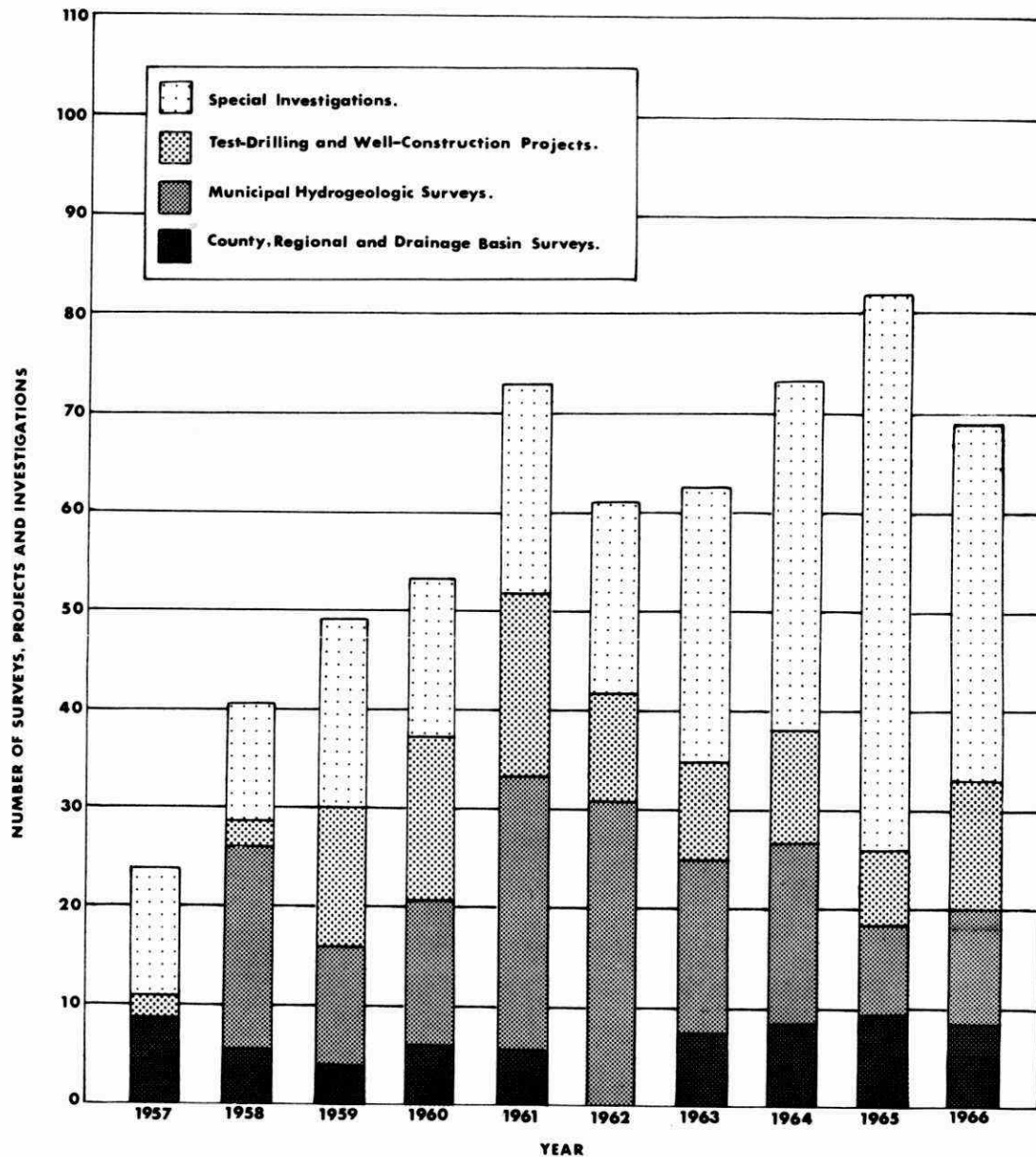


FIGURE 1. ACTIVE AND COMPLETED SURVEYS
PROJECTS AND INVESTIGATIONS

Handwritten note: Refer to page 10 for details

Field and office work was carried out for a ground-water resources survey of the Blezard Valley Region in the District of Sudbury. Preparations were completed for a test-drilling project to be undertaken in the region to locate and evaluate potential ground-water sources.

Municipal Hydrogeologic Surveys

Two municipal hydrogeologic surveys were carried forward from the previous year and 10 new surveys were initiated. The surveys consisted of an assessment of the local ground-water conditions and the reports contained recommendations regarding exploration and development of the resource. Surveys were continued for the City of Galt and the City of Guelph and carried out at the Police Village of St. Jacobs, the Hamlet of Courtland, the Village of Port Perry, the Village of Drayton, the Town of Latchford, the Township of North Gwillimbury-Keswick Area, the Townships of Shackleton and Machin-Fauquier, the Township of Coleman-Mileage 104, the Township of Machin-Vermilion Bay, and the Village of Alfred.

Reports were completed for three surveys carried out during the year, and nine reports were in progress at the end of the year.

Test-Drilling and Well-Construction Projects

The Branch participated in nine test-drilling projects and two well-construction projects during the year. Reports were completed for two projects carried out during the previous year.

Test-drilling projects were completed for the Police Village of Bourget, the Town of Richmond Hill, the Police Village of St. Jacobs, the Police Village of Plattsville, and the Community of Callander. Projects were started but not completed at the Community of Haliburton and the Village of Port Perry. At the end of the year preparations were in progress for test-drilling projects at the Village of Drayton and in the Blezard Valley Region.

All completed test-drilling projects were successful in locating ground-water sources of supply and included the development of production wells at Bourget and St. Jacobs. Offset drilling for the well-construction project at Orleans was in progress to locate

suitable water-bearing material at the proposed well sites and provide pilot holes for production wells.

Special Investigations

Thirty-six special investigations regarding ground-water contamination and water-supply problems were active or completed. Reports or memoranda were completed for six investigations carried out in 1965, and 27 carried out in 1966.

Six investigations involved the analysis and evaluation of the capabilities of municipal water-supply wells; eight investigations were made into problems of ground-water contamination; 12 investigations were made to evaluate the probable effects of the disposal of sanitary and industrial wastes on local and regional ground-water resources; and 10 investigations were made to provide assistance with regard to special water-supply problems.

Water and Well Management Branch

The activities of the Water and Well Management Branch were carried out under two distinct programs — water management and well-construction management.

The main activities under the water management program included processing of applications and permits for the taking of water, investigating complaints concerning reported interference with water supplies and inspections associated with enforcement of legislative requirements. Under the well-construction management program, activities mainly concerned checking the locations of new wells and their sanitary construction, investigating complaints against water-well contractors and possible infractions of statutes, and compilation of data for regulation of well construction in areas where flowing wells are encountered. Figure 2 shows the surface-water and ground-water investigations carried out since 1961 and the well-construction management investigations for the years 1965 and 1966.

DIVISION OF WATER RESOURCES
WATER AND WELL MANAGEMENT BRANCH

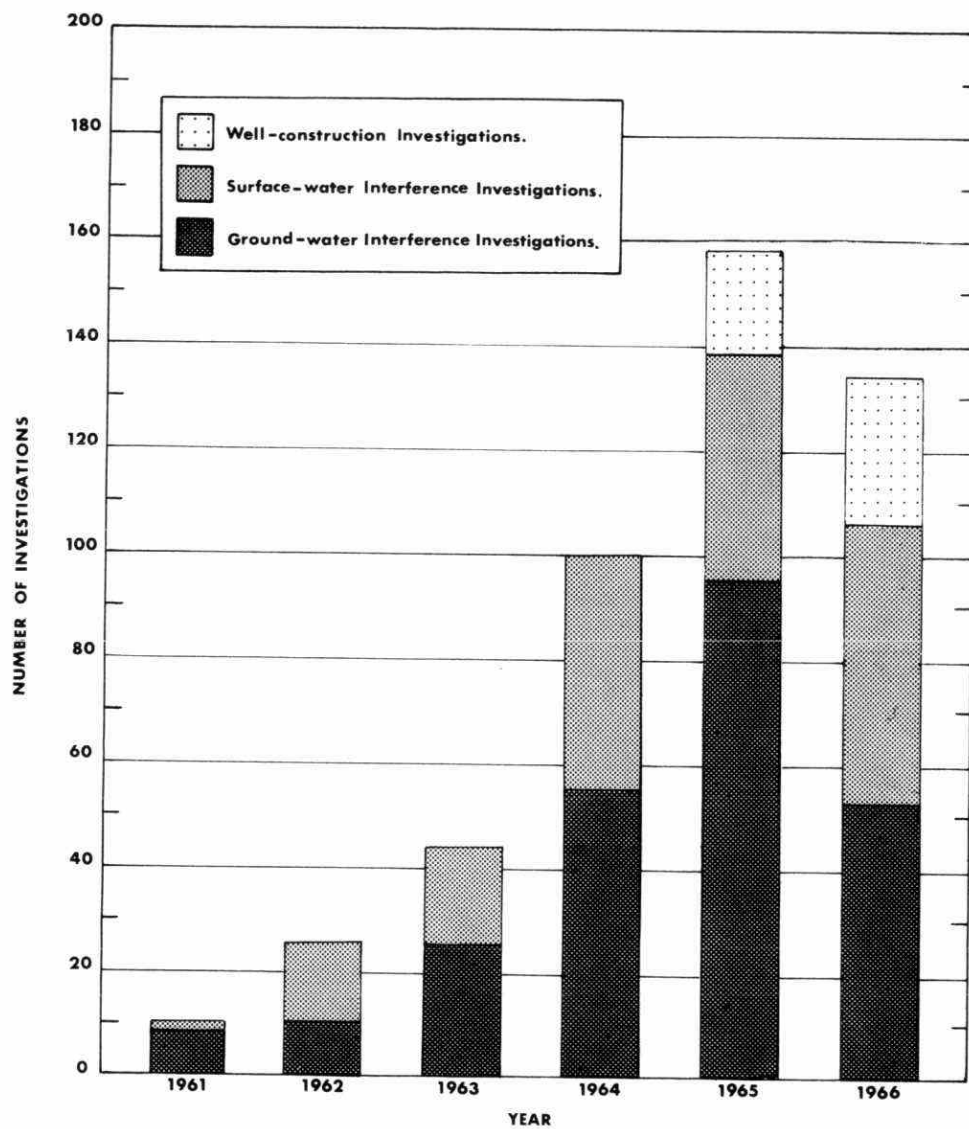


FIGURE 2. TYPES OF INVESTIGATIONS.

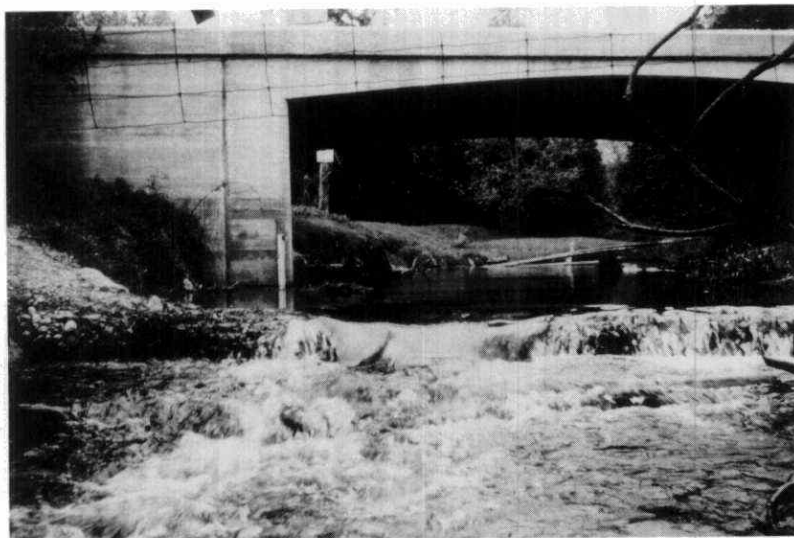
Note: Well-construction Investigations prior to 1965 were not recorded statistically.

Half Page

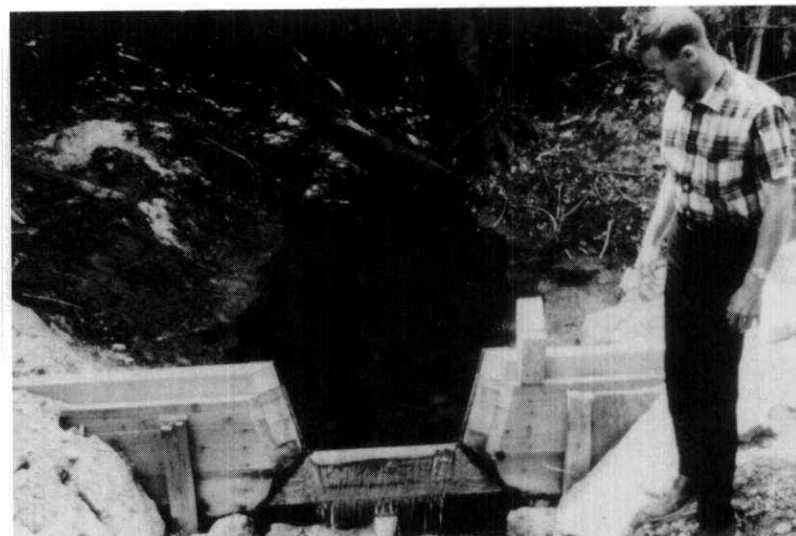
TABLE 2. SUMMARY OF WATER PERMIT DATA FOR 1966

SOURCE	APPLICATIONS						Amount of Water Taking Approved by Permit* (MGD)
	Carried Forward From 1965	Received In 1966	Refused Withdrawn or not Required	APPROVED		Under Consideration on December 31, 1966	
				By Letter	By Permit		
Ground Water	53	76	29	18	46	36	14.91
Surface Water	100	508	49	—	477	82	1406.11
Ground and Surface Water	2	13	2	—	9	4	2.50
	155	597	80	18	532	122	1423.52

*Does not include water takings approved by letter of approval or by 36 permits where conditions of taking rather than amounts were specified.



Submerged Gabion weir, all but invisible, used to improve accuracy of streamflow measurement.



Technician is observing operation of Trapezoidal weir, another device used to make measurements precise.

WATER MANAGEMENT PROGRAM

Applications and Permits

One hundred and fifty-five applications for permit to take water were carried forward from 1965. During 1966, 599 applications were received and 532 permits were issued. Eighty applications for permits were for takings not requiring authorization and the applicants were so notified. Of the permits issued, 406 were for irrigation, 33 were for municipal-supply purposes, 52 were for industrial purposes, 34 were for recreational purposes, seven were for commercial purposes, 477 were for takings from surface-water sources, 46 from ground-water sources and nine from combined surface-water and ground-water sources. On December 31, 1966, 63 applications were under active consideration and 58 applications were awaiting additional information. A total of 187 permits were cancelled, most because of a change in ownership of properties.

Table 2 contains a summary of water-permit data for 1966 while Table 3 shows the number of permits issued and the amount of taking authorized in 1966 according to drainage basin, source and purpose. Table 4 shows a comparison of permit data for the period 1961 to 1966 inclusive, and Table 5 is a summary of amounts of water taking approved by permit for various purposes since 1961.

Figure 3 shows graphically the amounts and purposes of authorized surface-water and ground-water takings since 1961.

Four maps, showing the locations of water takings and other relevant permit data, were completed during 1966 bringing the total number of maps produced since the program was initiated to 15. These maps were brought up to date periodically.

Charges were laid against a sand and gravel supply company. The company was convicted of violating a term of a permit to take water, issued by the Commission, by unduly depleting streamflow. Additional charges were withdrawn after the company demonstrated co-operation with the Commission.

Water Management Investigations

One hundred and six ground-water and surface-water interference problems were investigated during the year. The number of ground-water investigations was lower in 1966 than in 1965 while the number of surface-water investigations increased.

Ground-Water Interference Investigations

Fifty-two investigations of ground-water interference problems were carried out and reports were completed for 28 of the problems during the year. As in previous years a number of investigations were made on behalf of the Department of Highways, Ontario. Most of the investigations required repeated field trips to assemble sufficient data to resolve causes and responsibilities clearly.

The municipalities in which investigations were carried out are indicated below. The figures in brackets indicate the number of separate complaints where more than one was investigated.

Townships of Ancaster, Blanchard, Brantford, Chinguacousy (9), Clinton, Colchester South, Delaware, Derby, Dumfries South (4), Esquesing, Fenelon, Fisher, Gwillimbury West, Humberstone, Johnson, Markham, Mono, Mountain, Nissouri East and Oxford North, Oliver, Saltfleet (2), Scarborough, Stafford, Vaughan (3), Wainfleet, Walkerton, Waterloo, Westminster, Whitby (3), and Wilmot;
Towns of Fergus (2) and Hespeler;
Cities of Galt and Guelph (2).

Complex well-interference studies requiring numerous field inspections, were undertaken in the townships of Chinguacousy, and Guelph and Puslinch.

Township of Chinguacousy – A comprehensive survey was undertaken in the vicinity of the new Chinguacousy Municipal Well No. 5 as a number of complaints of well interference and streamflow stoppage allegedly due to the operation of the municipal well were received. It was concluded that serious interference had occurred due to the operation of the municipal well. A num-

TABLE 3. PERMITS ISSUED AND TAKINGS AUTHORIZED IN 1966 ACCORDING TO DRAINAGE BASIN, SOURCE AND PURPOSE

DRAINAGE BASIN	SURFACE WATER					GROUND WATER					COMBINED TAKING				
	COMM.	IND.	IRR.	MUN.	REC.	COMM.	IND.	IRR.	MUN.	REC.	COMM.	IND.	IRR.	MUN.	REC.
<i>Ontario River</i> St. Lawrence River		2 16,800,000	15 4,563,633	2 S.C.	3 35,000		1 250,000		4 844,700				1 123,000		
Lake Ontario	3 825,000	6 1,126,592,000	112 16,494,698	6 7,260,000	15 S.C.	1 160,000	2 3,130,000	1 172,800	4 1,566,720	1 28,800			2 80,000		
Lake Erie		4 6,368,000	172 44,493,716		1 S.C.	1 72,000	3 1,345,000	8 1,647,040	6 3,359,400				5 1,922,300		
Lake St. Clair		5 52,994,000	12 2,799,667	1 S.C.			5 659,600								
Lake Huron	2 390,000	11 18,366,000	78 21,932,867	3 4,112,500	14 S.C.		2 572,000		5 510,075						
Lake Superior		3 61,080,000					1 576,000		1 15,000			1 370,800			
Hudson Bay		6 20,983,000		1 18,000											
TOTALS	5 1,215,000	37 1,303,183,000	389 90,284,581	13 11,390,500	33 35,000	2 232,000	14 6,532,600	9 1,819,840	20 6,295,895	1 28,800		1 370,800	8 2,125,300		
GRAND TOTALS		477 1,406,108,081					46 14,909,135					9 2,496,100			

NOTE: (i) In each square the number of permits issued appears above with the amount of authorized water takings in Imperial gallons per day.

(ii) S.C. — Permits are issued under special conditions; no rates or amounts of water takings are specified.

(iii) Purposes — COMM. — Commercial; IND. — Industrial; IRR. — Irrigational; MUN. — Municipal; REC. — Recreational.

millions of 5-gal. GPD
2 decimal points
at 0.00

ber of supplies were restored based on a preliminary report, and a full report was being prepared to deal with outstanding complaints.

The investigation of complaints of well interference allegedly due to the operation of the Brampton-Huttonsville municipal well continued in 1966. Three private water supplies in the vicinity of the municipal well were restored by Brampton on the recommendation of the OWRC. Many of the complaints of interference investigated proved to be due to causes other than the operation of the municipal well.

Townships of Guelph and Puslinch – Considerable time was spent in the vicinity of Guelph obtaining information on ground-water conditions prior to and during the test pumping of a number of test wells by the City of Guelph. This information will assist in the settlement of disputes that may arise if the city establishes municipal wells that cause serious interference with private water supplies.

Township of Westminster – Regular monthly water-level measurements were taken in a number of private wells in the vicinity of the London-White Oak municipal well field in a continuing effort to establish the degree of interference, if any, caused by the operation of the municipal wells.

Surface-Water Interference Investigations

Fifty-four investigations of complaints concerning interference with surface-water supplies or depletion of streamflow were made and reports were completed for 50 of the investigations.

The municipalities where investigations were carried out are indicated below. The figures in brackets indicate the number of investigations in municipalities where more than one problem occurred.

Townships of Adjala (2), Albion, Ancaster (2), Brantford, Caradoc, Carnarvon, Charlotteville, Chinguacousy, Erin, Esquesing (2), Euphemia, Flamborough East, Georgina, Guelph and Puslinch, Gwillimbury East, Gwillimbury East and West, Gwillimbury East and Whitchurch, Hungerford and

Richmond, Keppel, Malahide, Markham, Middleton, Mono, Murray, Nassagaweya (2), Niagara (2), Oakland, Oxford East, Scott, Scott and Uxbridge, Sidney, Southwold, Sunnidale, Sydenham, Tecumeth, Tosorontio (2), Townsend, Vaughan (3), Whitby, Whitchurch (4) and Windham; Town of Oakville (2).

The investigation of a number of complaints of streamflow depletion against a golf course led to the recommendation that the golf course be required to obtain a permit to take water although under normal circumstances the taking of water would not require authorization from the Commission.

Water-Taking Investigations

Farm-to-farm surveys were carried out in parts of the Townships of Eramosa, Guelph, Nassagaweya, Niagara and Puslinch. The surveys were designed to determine the number of users of water who were subject to regulation by permit.

During the year a total of 575 farms were visited by members of the staff. The water-taking practices of 98 permit holders were checked. Two hundred and sixty farm operators were visited specifically to obtain data required to process applications for permits or check on locations and sources. One hundred and twelve applications for irrigation permits were obtained.

WELL CONSTRUCTION MANAGEMENT PROGRAM

Well Contractors

Four hundred and nine licences were issued in 1966 for carrying on the business of boring or drilling wells for water. Sixteen licences were held by boring contractors and 393 licences were held by drilling contractors. Records for 8,648 water wells were received by the Branch during 1966. The number of records received annually for the years 1951 to 1966 inclusive is shown in Figure 4. The four inspectors visited water-well contractors on 1,103 occasions and made 7,540 checks on the locations of wells and 328 checks for sanitary well construction.

Meetings with representatives of the Canadian Water Well

TABLE 4. COMPARISON OF PERMIT DATA FOR PERIOD 1961 - 1966

SOURCE AND PURPOSE OF WATER TAKING	1961		1962		1963		1964		1965		1966	
	No. of Permits Issued*	Amount (MGD)	No. of Permits Issued*	Amount (MGD)	No. of Permits Issued*	Amount (MGD)	No. of Permits Issued*	Amount (MGD)	No. of Permits Issued*	Amount (MGD)	No. of Permits Issued*	Amount (MGD)
GROUND WATER												
Commercial	4	0.26	15	3.02	3	0.13	14	1.08	4	0.33	3	0.23
Industrial	5	0.60	19	4.01	11	5.15	10	2.98	21	2.54	17	6.53
Irrigation	3	0.38	14	3.05	23	5.36	10	1.70	28	2.77	9	1.82
Municipal	8	6.53	32	8.65	30	16.06	45	10.86	24	11.15	34	6.30
Recreation	—	—	—	—	—	—	1	0.14	—	—	1	0.03
	20	7.77	80	18.73	67	26.70	80	16.76	77	16.79	64	14.91
SURFACE WATER												
Commercial	1	0.02	20	0.86	2	0.23	4	0.40	3	1.03	5	1.22
Industrial	6	9.74	7	6.44	14	21.23	27	326.16	27	945.37	37	1303.18
Irrigation	—	—	21	4.88	2599	767.13	230	49.79	556	131.00	389	90.28
Municipal	—	—	4	3.48	7	5.18	7	92.76	7	20.34	13	11.39
Recreation	1	—	17	—	11	0.93	49	0.09	47	0.05	33	0.04
	8	9.76	69	15.66	2633	794.70	317	469.20	640	1097.79	477	1406.11
GROUND AND SUR- FACE COMBINED												
Commercial	—	—	—	—	—	—	—	—	—	—	—	—
Industrial	—	—	—	—	—	—	—	—	—	—	1	0.37
Irrigation	—	—	2	0.95	6	1.6	—	—	5	1.05	8	2.13
Municipal	—	—	1	—	—	—	—	—	—	—	—	—
Recreation	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	3	0.95	6	1.6	—	—	5	1.05	9	2.50
	28	17.53	152	35.34	2706	823.00	397	485.96	722	1115.63	550	1423.52

*Includes Letters of Approval

Note: The amounts do not include water takings approved by letters of approval or by permits where conditions of taking rather than amounts were specified.

DIVISION OF WATER RESOURCES WATER AND WELL MANAGEMENT BRANCH

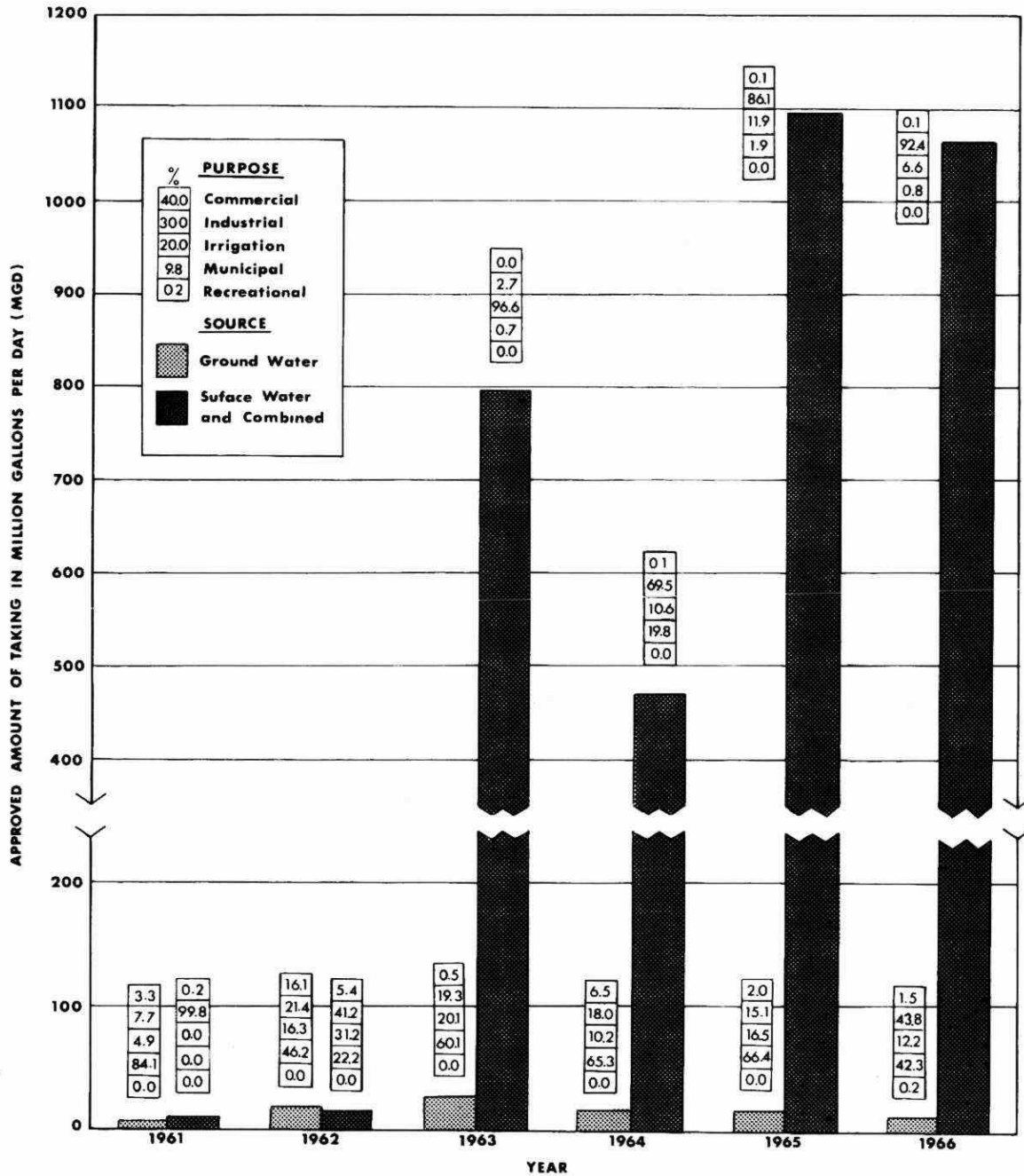


FIGURE 3. AMOUNT OF WATER TAKING AUTHORIZED BY PERMIT
ACCORDING TO YEAR SOURCE AND PURPOSE.

Sept. 1961 for each year and %

Contractors Association concerning proposed changes to legislation relating to the well-construction industry were continued during 1966.

Legislation was enacted which will allow the Commission to license persons who operate equipment for the boring or drilling of wells for water and to prescribe qualifications for such persons.

Convictions were obtained against three well contractors for installing well casing of other than new material or for carrying on the business of drilling wells for water without being the holder of a licence therefor from the Commission. One of the contractors was convicted on two occasions for carrying on the business of drilling wells for water without a licence and was charged for a third offence.

A charge was laid against a well contractor for failing to seal the upper open end of a well casing in a manner sufficient to prevent contamination of the well. The hearing of the charge was scheduled for January, 1967.

A charge laid in 1965 against a well contractor, for failing to seal salty water encountered in his drilling that might impair the quality of potable ground water, was withdrawn when the contractor returned to the well and sealed it in a manner satisfactory to the Commission.

DIVISION OF WATER RESOURCES
WATER AND WELL MANAGEMENT BRANCH

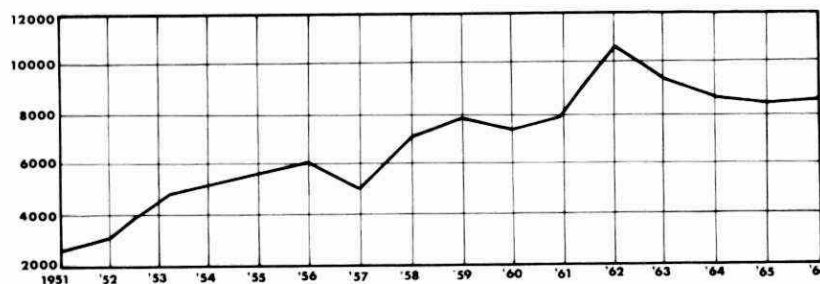


FIGURE 4. NUMBER OF WATER WELL RECORDS RECEIVED ANNUALLY.

Investigations Concerning Well Regulations

Twenty-eight investigations concerning well regulations were carried out during the year and reports were completed for 22 of these. A number of the investigations required more than one field inspection.

The municipalities where investigations were carried out and the number of investigations in municipalities where more than one problem occurred are listed below:

Township of Albion, Brantford, Burleigh and Anstruther, Cartwright, Chatham and Sombra, Chinguacousy, Clark, Ernestown, Euphrasia, Flamborough West, Harvey, Innisfil, King, Kingston, Landsdowne, Markham, Mono, Orillia, Portland, Sandwich South, Toronto Gore, Vaughan (2), Whitby East and Whitchurch;

Towns of Collingwood, Oakville and Pembroke.

TABLE 5. SUMMARY OF AMOUNTS OF TAKING
APPROVED BY PERMIT FOR VARIOUS PURPOSES

PURPOSE	1961 MGD	1962 MGD	1963 MGD	1964 MGD	1965 MGD	1966 MGD
Commercial	0.28	3.88	0.36	1.48	1.36	1.45
Industrial	10.34	10.45	26.38	329.14	947.91	1310.08
Irrigation	0.38	8.88	774.09	51.49	134.82	94.23
Municipal	6.53	12.13	21.24	103.62	31.49	17.69
Recreation	—	—	0.93	0.23	0.05	0.07
TOTALS	17.53	35.34	823.00	485.96	1115.63	1423.52

Note: The amounts do not include water takings approved by letters of approval or by permits where conditions of taking rather than amounts were specified.

Hydrologic Data Branch

The Hydrologic Data Branch continued the collection, analysis and distribution of hydrologic data. The operation of basic networks for the measurement of streamflow and ground-water levels was augmented by specific hydrometric activities for programs of water quality monitoring, radiological investigation, and Northern Ontario Water Resources Studies. Information on streamflow, ground-water levels and aquifer conditions was made available to the public and to Commission staff.

Observation Wells

At the end of the year, 110 observation wells were in operation from which water level data were received and plotted on a regular basis. Twenty new wells were established, and readings from seven wells were discontinued. Most of the new wells were established in areas for which little information had been available on the fluctuations of ground-water levels. Figure 5 shows the number of observation wells in operation at the end of each year since 1957. All observers operated on a voluntary basis and rendered valuable public service.

Hydrogeologic Data

Water-well records submitted by licensed boring and drilling contractors in accordance with the OWRC Act are filed by the Branch for use by the public and staff. A total of 8,648 water-well records were received during the year. Hydrogeologic data from the well records and from the observation wells are published in the form of ground-water bulletins. During the year, *Ground Water Bulletin No. 4, Ground Water in Ontario, 1958*, was published. Printing of *Ground Water Bulletin No. 5* for the year 1959 was virtually complete at the end of the year. Printing of *Ground Water Bulletin No. 6* for the Southwestern Area of Ontario for the years 1960-1963 was commenced.

Surface-Water Hydrometric Installations

At the end of the year the Branch maintained or supported a total

of 88 permanent streamflow gauging stations. Forty-two stations were manually operated and the remaining 46 were fitted with automatic recorders. Figure 6 shows the type and number of permanent streamflow stations in operation since 1963.

Forty-seven of these stations were operated under a co-operative program with the federal Department of Energy, Mines and Resources. Seventeen automatic recording stations and five staff gauges for lake level measurements were installed in 1966 under this program.

The Branch operated one automatic recording station and 40 manual stations. Twenty-seven of the manual stations were operated to collect data for the water quality monitoring program of the Division of Sanitary Engineering and 13 were for the radiological pollution investigations.

Temporary streamflow gauging stations were established by other branches for specific purposes during the year. Some will be in operation for a number of years while others were discontinued when the particular studies were concluded. The numbers and types of stations are summarized below according to branch:

	AUTOMATIC	MANUAL
RIVER BASIN RESEARCH	14	3
WATER AND WELL MANAGEMENT	9	2

Synoptic Survey

A draft report of the Synoptic Survey for the year 1964 was prepared and was under review. Streamflow measurements were made in the following study areas: Big Otter Creek, Lynn River, Bronte Creek, Holland River, Coldwater River, Ganaraska River. Four hundred and fifty-two measurements were made at 217 stations. Three hundred and fifty-nine observations of ground-water levels were made in 115 wells.

International Hydrologic Decade

The assessment of ground-water conditions in various areas of the Province forms part of the International Hydrologic Decade program which is carried out by the Branch. Test-drilling and pumping tests were carried out in two sand plains in South-

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HYDROLOGIC DATA BRANCH

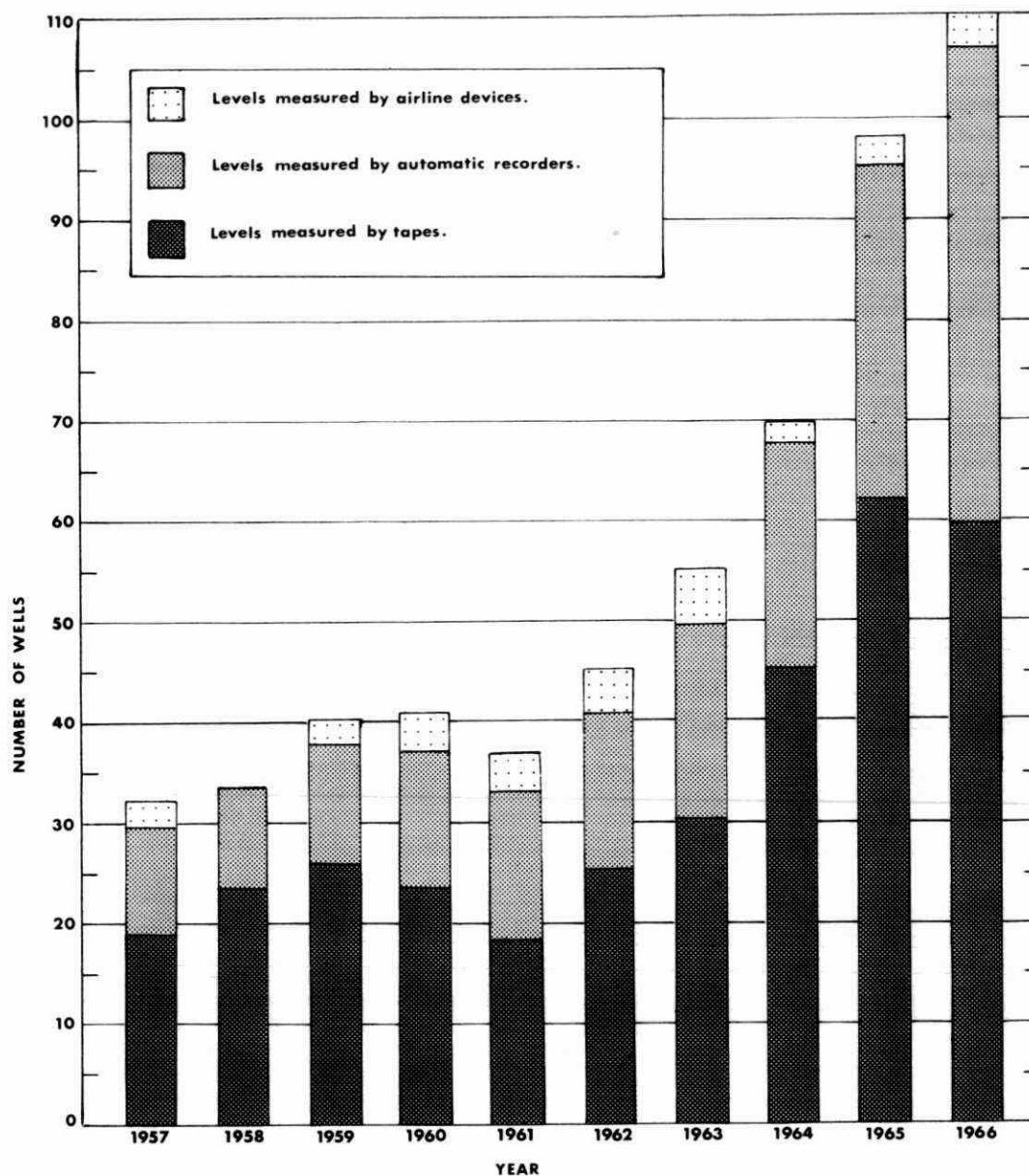


FIGURE 5. OBSERVATION WELLS IN OPERATION

DIVISION OF WATER RESOURCES
HYDROLOGIC DATA BRANCH

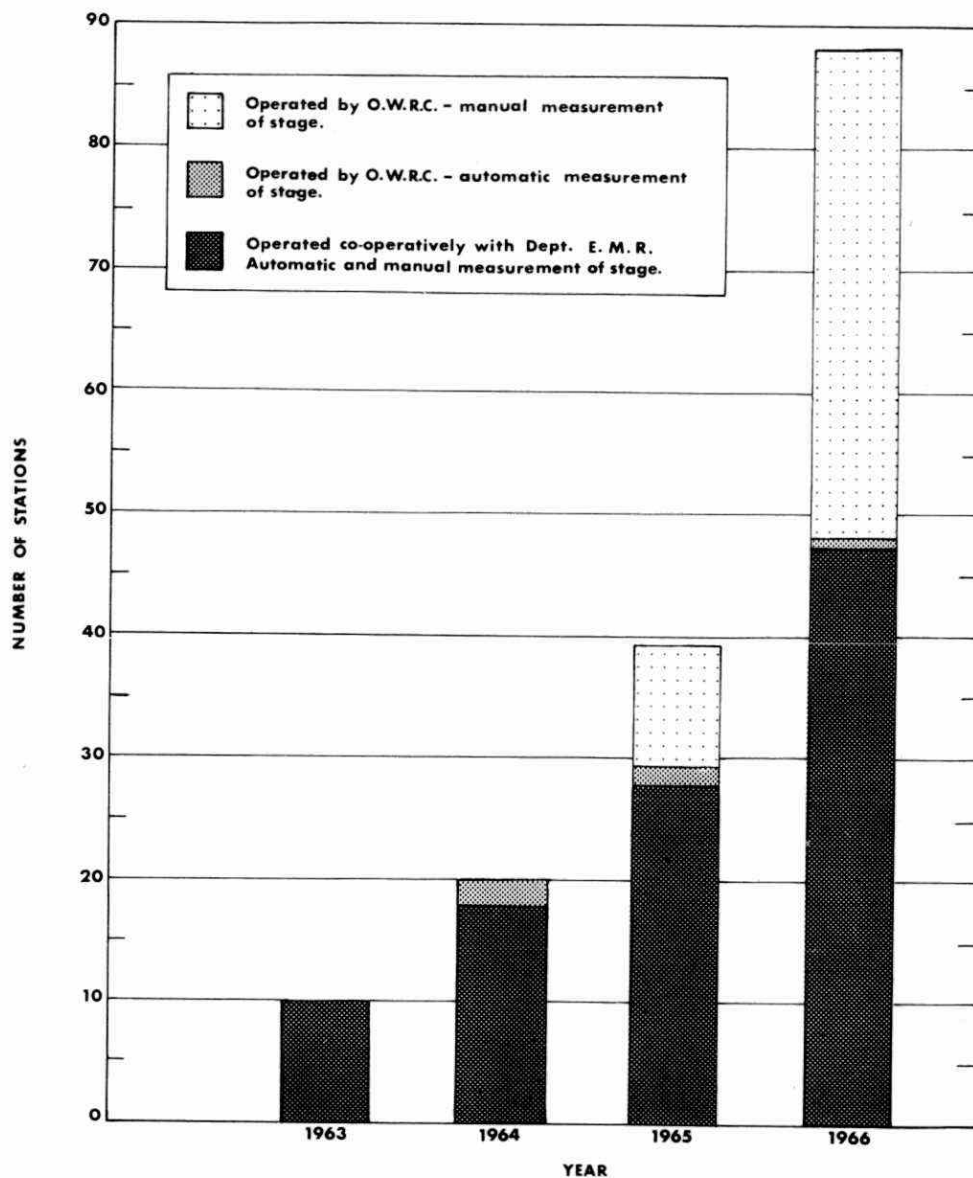


FIGURE 6. STREAMFLOW GAUGING STATIONS OPERATED BY THE BRANCH OR MAINTAINED CO-OPERATIVELY WITH THE FEDERAL GOVERNMENT.

western Ontario in the Town of Bothwell and in the Township of Colchester South near Harrow. Analysis of the results for the determination of the aquifer characteristics and the preparation of a report were in progress. Planning for the construction of observation wells and the performance of pumping tests in another area were being actively pursued.

Northern Ontario Water Resources Studies

Investigation of the major river basins of northern Ontario commenced. A party of three staff members assisted by a summer student and local casual help spent a field season of three months in the area. The work consisted of reconnaissance investigation of the area; investigation of 32 sites for suitability as hydrometric stations; a more detailed investigation of geology, vegetation, characteristics of rivers and water quality; and streamflow gauging and the establishment of arbitrary bench marks at nine sites.

The Branch reviewed the network of precipitation stations with the Meteorological Branch of the Canada Department of Transport and requested that 13 stations be added to those in service. Nine recording type precipitation stations were installed. Echo sounding and the calculation of the storage capacity of four lakes were carried out to complement the estimating of lake volumes from surface water temperatures measured by an airborne radiation thermometer, being done by the Meteorological Branch.

A technician was assigned to work with the Water Resources Branch of the federal Department of Energy, Mines and Resources in the co-operative installation and maintenance of streamflow gauging stations in northern Ontario. Eleven automatic recording water level stations and five staff gauges for lake-level measurements were installed during the year.

A report of the year's activity was under preparation.

Radiological Pollution Investigation

Hydrometric measurements were taken at 20 sampling stations in the Elliot Lake and Bancroft areas to support studies of the quan-

ties and movements of radioactive pollutants. One recording and 13 manual streamflow stations were established. A total of 135 streamflow measurements were taken.

River Basin Research Branch

The activities of the River Basin Research Branch included much of the work undertaken in the Commission as part of the International Hydrologic Decade and specialized studies including electric well logging and geophysical surveys. Support was given to other branches of the Division through the operation of the geophysical equipment and by the carrying out of laboratory analyses on formation samples submitted from various drilling projects.

Representative Basin Studies

The study of hydrologic conditions in five drainage basins representative of major geomorphologic regions in southern Ontario continued as an International Hydrologic Decade project.

Eight automatic streamflow gauging stations were installed in the basins. One hundred and eighty-eight flow measurements were taken at 20 stations. Forty-four observation wells were installed in three basins and seven soil moisture measurement tubes in one. In co-operation with the national Department of Transport, one main and 11 satellite climatological stations were installed at Bowmanville along with four storage rain gauges and 12 snow courses.

Blue Springs Creek

Studies in the Blue Springs Creek basin are being carried out in co-operation with the University of Guelph.

Sixteen observation wells, 11 small and five large diameter, were installed. Electrical well logging was carried out in all of the large diameter wells before they were equipped with automatic recorders. Short-term pumping tests were carried out on two of the large diameter wells. Electrical resistivity studies were started

in the basin near existing observation-well sites. Three sets of streamflow measurements were undertaken at seven metering stations.

Bowmanville, Soper and Wilmot Creeks

Four automatic streamflow gauging stations were installed and two artificial controls were constructed to stabilize pond conditions at two stations in the basin of Bowmanville, Soper and Wilmot creeks. Fifteen sets of streamflow measurements were undertaken at seven gauging stations to establish rating curves.

Twenty-one observation wells – 13 large and eight small-diameter – were installed. Most of the large-diameter wells were electric logged before they were equipped with automatic recorders. Short-term pumping tests were carried out on two observation wells to determine aquifer characteristics. Seven soil moisture measurement stations were established.

Geologic field mapping of Pleistocene deposits and detailed office work to analyze hydrogeologic conditions were started.

East and Middle Oakville Creeks

Four automatic streamflow gauging stations were installed and a concrete measuring weir was constructed at one station on East Oakville Creek. Eleven sets of streamflow measurements were undertaken at three stations to establish rating curves.

Seven observation wells, two large and five small diameter, were installed. The large-diameter wells were electric logged and equipped with automatic recorders.

Proposed observers were contacted with respect to the collection of meteorological data.

Venison Creek

On Venison Creek 10 sets of streamflow measurements were made

at three stations. Automatic recorders were installed on three of the wells installed during 1965 and 10 well-measurement surveys were carried out on the seven wells.

Wilton Creek

Very little progress was made in the Wilton Creek Basin. Field investigations were undertaken to assess geologic conditions and determine proposed observation-well locations.

Experimental Basin Studies

Literature reviews and other office studies were continued to determine the necessary requirements of experimental basins and to assess the suitability of two basins, Stayner and Alder Creek, which are presently under consideration.

Geophysical Investigations

The electric well logger was operated in seven wells in addition to those in representative basins. Six of these wells were being studied by other branches of the Division and the seventh by Queen's University in Kingston.

Electrical resistivity and seismic investigations were undertaken in the Blezard Valley region in support of a forthcoming test drilling project to be undertaken by the Surveys and Projects Branch.

Special Studies

Sieve analyses were carried out on 45 samples submitted by the Hydrologic Data Branch and on 20 samples submitted by the Surveys and Projects Branch. The Branch aided in the pumping tests conducted by the Hydrologic Data Branch at Harrow and Bothwell and carried out three field investigations into streamflow interference for the Water and Well Management Branch.

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